VOL. LXXVIII. No. 2005. [All Rights Reserved.] APRIL 28, 1916. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 6d.; Canada, £1 2s. 10d. ($5.50); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie Etrangère, 22, Rue de la Banque.
Telegraphic Address: "Ageekay, London." A B C Code. Telephone Nos. City 927; Central 4425 (Editorial only).

MOULDED INSULATORS
Of all Descriptions.
LITHOLITE, Ltd.,
55-57, Hackney Grove, London, N.E.

WIRES
THE GENERAL CABLE MANUFACTURING CO., LTD.,
Imperial House, Kingsway, London, W.C.
Phone: Regent 5781.
CABLES

FURNACES for WHITE METALS, &c.
(Hall's Patents),
For Cable, Pipe and Accumulator Work.
Without Oxidation. Automatic Heat Control.
Enormous Saving in Residue.
Easy payments arranged in special cases.
Monometer Manufacturing Co., Ltd.,
22, Whitehouse St., Aston, BIRMINGHAM.

CABLES BLACK ADHESIVE TAPES AND PARA RUBBER TAPES AND CHATTERTON COMPOUND.
The Teleklyt Cable & Para Rubber Co.,
38, Bath Street, Glasgow, Scotland.

BROOK MOTORS.
See Advertisement, Sup. 89.

SWITCHGEAR.
ERNEST F. MOY, LTD.,
Manufacturing Electrical Engineers and Government Contractors.
GREENLAND PLACE, CAMDEN TOWN, LONDON.

TAYLOR & CO.
MICA & MICANITE
INSULATION.
TELEPHONE:—CENTRAL 4575.
40, HATTON GARDEN, LONDON, E.C.

The Croft Granite, Brick & Concrete Co., Ltd.,
CROFT, near LEICESTER,
for CONCRETE ADAMANT SWITCH CELLS.

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

COOPER HEWITT LIGHT.
24 hours' daylight. Write for List No. 273.
THE WESTINGHOUSE COOPER HEWITT CO., LTD.,
80, York Road London N.

IRONCLAD SWITCHGEAR.
M.E.M.
MIDLAND ELECTRIC MFG. CO., LD.
REA ST. SOUTH, BIRMINGHAM.

WESTERN-ELECTRIC
COMPANY, LIMITED,
Norfolk House, Victoria Embankment, W.C.
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement last week, Sup. 20.

CONNOLLY BROS., Ltd.,
for
WIRES AND CABLES.
See Advertisement this week, p. iii.

WHITE
Electrical Instrument Co.
2 & 4, GLOUCESTER ST., CLERKENWELL, LONDON, E.C.

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

INSULATING - - BEADS - -
Immediate Delivery.
H. HARTJEN & Co., 35/37, Noble St., London, E.C.

CABLES AND WIRES.
SWITCHBOARDS.
ARC LAMPS.
JOHNSON & PHILLIPS, LTD.,
CHARLTON, LONDON, S.E.

AIR COMPRESSORS & VAC. PUMPS, Desiccators Sets.
NORMAN DICKSON, PRINGLE & Co.
Cable Pumps & Impregnators.
25, Victoria St., Westminster.

LARGE STOCK KEPT FOR QUICK DELIVERY
SHUNT REGULATORS,
MOTOR STARTERS and all classes of Resistance Work.
The SOLENOID REGULATOR Co., Highgate Sq., Camp Hill,
Telephone: Midland 682. BIRMINGHAM Telegrams: "Solenoid, Birmingham."

BLANKS. PIERCING.
STAMPINGS.
METAL.
HAROLD, HARLEY & Co.,
Harley Works, Beckton Road, London, E. 'Phone: East 1300.

STONE'S ELECTRICAL INSTALLATIONS for RAILWAY CARRIAGES.
60,000 COACHES EQUIPPED ALL OVER THE WORLD.
J. STONE & COMPANY, Ltd.,
Deptford, London.

THERMIT, LIMITED,
675, COMMERCIAL ROAD,
'Phone: EAST 4157. LONDON, E. 'Grams: "Fulmen, Step, London."
PATENT
Alumino Thermic Welding Process.

VICTORIA DYNAMO & MOTOR CO.,
CRAVEN HOUSE, KINGSWAY, LONDON.
Send for Stock List of Motors ready for delivery.

INGLEBY & CO., LTD.
ELLAND ROAD, LEEDS.
MOTORS FOR DIRECT AND ALTERNATING CURRENT
Tel. 378
Delivery from Stock up to 50 H.P.

Advertisement Index, see page xx.

LIGHTHOUSE SUPPLIES.

STOCK DELIVERY

of

CREAM PORCELAIN CEILING ROSES, BOW CUT-OUTS, CONNECTORS.

ORDERS BOOKED FOR FORWARD DELIVERY OF LAMP HOLDERS, KEYSWITCH HOLDERS.

WE CAN QUOTE KEEN PRICES.

THE ELECTRICAL SUPPLIES CO.

(PROPRIETORS: THE E.S. COMPANY, Ltd.),

THE "LIGHT HOUSE," 233, TOTTENHAM COURT ROAD, LONDON, W.

Telephone: Museum 2516—7. Telegrams: Elecsplico Ox, London.

MANCHESTER DEPOT: 40, VICTORIA BUILDINGS. Manchester Telephone: City 5794.

TURBO BLOWER 2,000 B.H.P.

FRASER & CHALMERS'

RATEAU STEAM TURBINES . . .

High, Low & Mixed Pressure Types.

TURBO BLOWERS

From 5,000 cu. ft. per Minute up.

AUXILIARY TURBINES

(TERRY).

TURBO GENERATORS

From 250 KW. up.

TURBO COMPRESSORS

From 5,000 cu. ft. up.

2,000-KW. MIXED PRESSURE TURBINE, 3,000 R.P.M.

FRASER & CHALMERS, Ltd.

London Office
3, LONDON WALL BLDGS., E.C.

Works & Offices:
ERITH ENT.

THE

ELECTRICAL REVIEW.

VOL. LXXVIII. APRIL 28, 1916. No. 2,005.

ELECTRICAL REVIEW.

Vol. LXXVIII.] CONTENTS: April 28, 1916. [No. 2,005.

	Page
Industrial Fatigue	469
Business-Getting Abroad	470
The Electrical Trade after the War	471
Lead	471
Gas-Filled Rectifiers (*illus.*)	472
Meter Errors in Parallel Supply of Fluctuating Loads (*illus.*)	473
New Electrical Devices, Fittings and Plant (*illus.*)	474
Substitutes for Oil in High-Pressure Switchgear	474
Insulating Oils for Transformers	475
An Electrolytic Oxygen and Hydrogen Installation (*illus.*)	475
Diesel Engine Users' Association	476
Correspondence—	
"Glow Lamps"	476
Electricity in War Areas	476
The Resistance of a Cubic Frame of Wire	477
War Items	477
Legal	478
Business Notes	480
Notes	484
City Notes	487
Stocks and Shares	489
Market Quotations	490
Exports and Imports of Electrical Goods during March, 1916	491
Some Legal Hints to those who sell Machinery	492
The Use of Continuous Current for Terminal and Trunk Line Electrification	493
Electric Power in Slate Quarries, by G. K. Paton (*illus.*)	494
Foreign and Colonial Tariffs on Electrical Goods	496
New Patents Applied for, 1916	496
Abstracts of Published Specifications	496
Contractor's Column	Advertisement page xviii

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEKKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 4d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 81a, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N Z.: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1916 EDITION

READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

INDUSTRIAL FATIGUE.

ONE of the most interesting and important classes of scientific investigation that have attracted attention in recent years is that which relates to the psychological and physiological conditions of labour, and their bearing upon the output and physical well-being of the worker. The subject has been studied from various aspects—from the points of view of the works manager, the professional psychologist, and the social economist—and many valuable deductions have been made from the data accumulated by experiment and experience. Mr. F. B. Gilbreth, an American engineer, was early in the field with his extended researches into the elimination of wasted effort, the results of which were embodied in his classic work on "Motion Study," a book which ought to be in the hands of every works manager and foreman; particularly in view of the supreme necessity with which we are now confronted, of economising labour and increasing output to the utmost, is it desirable that the lessons taught in this book should be laid to heart and carried into practical effect by every manufacturing firm, and we should be glad to see instructional classes established for the promulgation of the ideas which Mr. Gilbreth has developed. The point of view of the psychologist is admirably set forth in "Psychology and Industrial Efficiency," by a German-American, Prof. Hugo Münsterberg. This author studied the application of psychological experiment to the service of commerce and industry; whereas Gilbreth was concerned with the movements of the limbs and body of the workman, Münsterberg investigated the operations of his mind, the mental qualities and peculiarities of individuals, and the fitness of each person for his chosen vocation, together with the numerous problems arising out of these researches. This, again, is a work with which every manager should be familiar.

Within the past year the Health of Munition Workers' Committee has made a study of the causes and effects of industrial fatigue, the fruits of which have been embodied in a Memorandum that has recently been issued, and in this case not only the production of the workman, but also its reaction upon his person have been considered, with scientific thoroughness. We are taught that industrial fatigue is a nervous not a muscular phenomenon, and that by the proper organisation of periods of work and rest the nervous system may be so trained as to attain far higher efficiency than could otherwise be reached. It is to this aspect of the industrial problem that we wish to direct particular attention.

The bodily sensations which suggest to us the onset of fatigue have in fact little to do with the question; real fatigue "is shown and is measurable *by the diminished capacity for performing the act that caused it.*" The fundamental condition for maximum efficiency—that is, maximum output combined with the maximum of comfort and health to the worker—is the proper alternation of work and rest periods. This is one of the conditions laid down by Mr. Gilbreth also.

Rest should not be deferred until symptoms of muscular fatigue appear, for nervous fatigue commences to show its effects before the former by an unobserved but measurable slackening of speed.

Moreover, if the fatigue is allowed to progress too far, its effects cannot be dispelled by the normal period of rest, but will be felt during the following work period. Hence such conditions of working are wasteful and should be avoided.

In the report before us, emphasis is laid upon the fallibility of mental impressions as to output and upon the necessity of measurement in order to obtain reliable guidance; this is a very significant circumstance, for it reveals the fact that empirical methods and guesswork are being replaced by scientific methods of investigation. Accurate measurement is the foundation stone of all branches of science; some subjects of study cannot readily be subjected to measurement, and have consequently remained to this day in what Lord Kelvin used to call the "natural history" stage of development, whilst others, more amenable to measurement, have long been on the "natural philosophy" plane. The fact, therefore, that measurement is now seen to be essential to the securing of reliable results in the study of industrial fatigue indicates that great progress has been made towards its scientific treatment.

We have not space here to quote freely from this valuable report, but may say that results described as "astonishing" have already been gained *in other countries* by the application of experiment; that reduction of working hours and the adoption of a week-end rest have been proved to increase the output of workers to an extraordinary degree. Not only is slackness—or rather staleness, for it is observed in the most willing workers—an inevitable accompaniment of long hours and lack of rest, but also the effect upon the physical condition of the workmen is deplorable.

It is stated in the report that management based upon the experimental science of industrial fatigue is far less common in this country than in the factories of America and Germany; this is a grave circumstance urgently demanding a remedy, and we earnestly commend the document to the attention of all works managers, in the hope that they will profit by its teachings; we cannot afford to be handicapped in the industrial conflict which is impending. The subject has also been dealt with by a committee of the British Association, and references to publications bearing upon it will be found in our "Notes" to-day.

BUSINESS-GETTING ABROAD.

It is an extremely difficult matter at the present time to gauge the general industrial situation. There are certain sections of manufacturing, including parts of the electrical branch, which, if rumour be trustworthy, are experiencing a slight falling off in orders from the Government, while others report a drop in Colonial and foreign demands. The former, it is thought, may be due to the new Government munitions factories being now ready to assist materially in meeting the needs of the Forces, thus rendering private works less indispensable than they have been. If it be correct it may be only temporary—but who outside the charmed circle can say? If it is not temporary it means that the released factories, or part thereof, may be freer to undertake ordinary manufacturing business, assuming that sufficient suitable labour remains available after the Government draughts for the Forces and the Factory have been satisfied. The falling off in Colonial and foreign demands—if there be such a drop—may be due to the growing impression abroad that British manufacturers are unable to handle export business, or that the available shipping facilities are insufficient; it may be due to a definite fall in requirements owing to works being deferred; but it is little use trying to guess the causes until we know for a fact that there is an actual drooping of electrical export demand, for information from some of the Colonial markets and from Russia shows clearly that the shelves of the electrical stores are empty and that supplies of certain classes of goods are sold before they arrive; traders want all that they can get. The electrical export values for the last few months ought to be known in all our markets, to show purchasers how well we are maintaining such business. The shipping difficulty is undoubtedly a great one, and our trans-Atlantic cousins, whose assistance we appreciate, have not been slow to observe the adverse effect upon us, and the favourable effect upon themselves, of the great delays that have been involved in obtaining export permits from our Government departments. If export trade helps us to finance the war, the granting of permits should be speeded up. Indeed, everything that is possible should be done to convince the outer markets of our ambitions to supply their needs. Reference to speeches delivered at one of the cable manufacturing companies' meetings shows that the trading of the past year has raised the serious question whether refusal of orders under the stress of war conditions will mean loss of goodwill ultimately. In normal times it is easy enough to lose export connections; we remember the times when a good foreign connection having been made, a happy and prolonged relationship followed; there was little foreign competition in those days—the world naturally turned to England. Recently, even in peace-time, a foreign connection had to be continually nursed. In war-time, connections have had to be sacrificed, not at the bidding of competitors, but at the snorting of the war-horse. Can such connections be regained? What will happen in that matter will depend upon the hold that other manufacturing nations are able to gain while we are otherwise engaged, and upon whether such a service will be given at such a price that there shall be no inducement to change again. Of the activity of these other nations in pursuit of current business there is in our mind no doubt whatever. Reports from the different markets are a fairly safe guide, though we are interested to gather from an article in the *Daily Telegraph* that Mr. Edgcumbe Brighten, who has lately returned from the United States, finds that American business men are too concerned in reaping the harvest of the present trade boom to concern themselves with preparations for capturing overseas trade after the war. The present activities—apart altogether from anything special which may follow—must, however, be reckoned with, and British manufacturers cannot afford to allow any wrong impression regarding their future intentions to gain currency. We are told to-day on one hand that our engineering manufacturing capacity has been so greatly increased during the last twenty months that we shall have little difficulty, allowing for due adaptation, in meeting an enormously increased demand. This view was supported recently by Mr. G. Sutton in expressing his views regarding the future of the cable manufacturing industry, and he, as an experienced leader of the electrical industry, is entitled to our listening ear when he suggests as one possibility of such increased capacity, a cutting of prices between cable-makers. That is of course assuming that there will not be enough business available to keep all the works fully occupied. Mr. Sutton is a man who knows the world—we mean he is as capable as anybody of judging the prospects for future business in other countries, having, to his company's credit, among other things, the booking, just prior to the war, of perhaps the biggest export orders for electric power and traction cables—for Australia and South America—ever received in these islands. There is another view that is put forward, namely, that so huge will be the demand from the British Colonies and Dependencies,

from Allied countries and from neutral markets, almost immediately the war concludes, that we shall be unprepared to meet it satisfactorily. And between these two views there interposes the uncertainty as to the position that Germany and Austria will be permitted to occupy as electrical exporters after the war. Now if Mr. Sutton's view respecting the cable trade holds good in regard to other branches of electrical and engineering industry, one of the most urgent of all demands upon us is to take every precaution to strengthen and extend the selling organisation and keep ourselves well to the fore—even in these days, when we can only with difficulty meet the demand—in those parts of the world where we desire to trade. We may thus be ready to secure an increased demand which shall help to prevent the need for competitive cutting. If next we consider the interposing factor—possible resumption of German competition in some Colonies and present satisfactory neutral markets, we see again the necessity for following up our industrial organisation at Home with a boldly conducted campaign of salesmanship and publicity so that British ability and British quality shall be common knowledge among purchasers everywhere. Or, again, if we consider that the industrial menace of Germany will be broken at Home and in the Colonies and Allied countries so that the demand upon the new England's factories will be almost overwhelming, we shall still do well if we see to these important commercial aspects of our affairs. The British manufacturer needs to do more to impress the buyer abroad. The latter wants to know who's who; where he can buy this and that; and something about the suppliers and their works and ways. Our readers will think that we are reiterating a very old piece of our own trade advice. We do so because the present situation seems to us to call imperatively for a most spirited and energetic salesmanship and publicity policy on the part of the greater part of the industry. Our co-operative schemes are excellent—as far as they have gone; our discussions as to what we want, or ought, to do, or what somebody else ought to do, have been good, and we hope that their influence will spread; but we have yet to be convinced that there is an earnest, well founded, and general effort being made with a view to assuring that the Colonial and foreign markets shall yield us such a volume of business as shall make it possible to utilise to the full all the added factory capacity, after the war. What *is* the use of talking further about a Ministry of Commerce and other matters of the same class and *waiting*? We have got to help ourselves, and a strong self-help policy throughout the industry would mean definite action now to draw definite business later. Why not use part of the war profits now being earned, on this very reasonable expenditure? The war has disorganised ordinary business; to place it on a proper footing again certain measures of reorganisation will be essential; those measures will involve higher commercial activity, the cost of preparing for which can surely be treated as a legitimate working expense!

The Electrical Trade After the War.

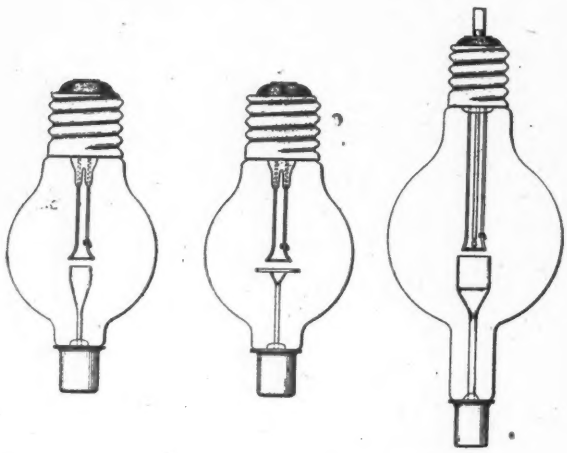
An important announcement has just been issued by the President of the Board of Trade. The Committee which is to consider and report upon the position of the Electrical Trades after the war, with special reference to international competition, and is to indicate what steps, "if any," are necessary or desirable in order to safeguard that position, has been appointed. Sir Charles Parsons, F.R.S., of turbine fame, and of C. A. Parsons & Co., Ltd., of Heaton Works, Newcastle-on-Tyne, is to be chairman, and the other members are:—Mr. J. Annan Bryce, M.P., Chairman of the British Westinghouse Electric and Manufacturing Co., Ltd., whose views on our trade relations with the enemy after the war, expressed at the annual meeting of that company, and reported in our issue of April 14th, page 431, assume an added interest by reason of his appointment; Mr. T. O. Callender, managing director of Callender's Cable and Construction Co., Ltd., who is also connected with several leading electric power companies and other undertakings, and who, by his long practical experience of the industry, is pre-eminently fitted to assist in these important trade deliberations; Mr. James Devonshire, A.I.E.E., managing director of the London United Tramway Company, who, as a director of a number of other power and tramway undertakings connected with the B.E.T. group, is well versed in matters relating to finance; Mr. Bernard M. Drake, M.I.E.E., chairman of the well-known business of Drake & Gorham, Ltd., and of the D.P. Battery Co., Ltd., who has known the electrical industry intimately for a very lengthy period; and Sir John Snell, a past president of the Institution of Electrical Engineers, and member of the eminent consulting engineering firm of Preece, Cardew, Snell & Rider. All communications for the committee should be addressed to the Secretary, Electrical Trades Committee, 7, Whitehall Gardens, S.W. Our only comment at the moment is that we hope that the committee have power to add to their number.

Lead.

The position of lead has continued to be the subject of considerable interest. Between the restrictions imposed upon trading by the new regulations and the growing scarcity of supplies consequent upon the general small arrivals for some time past, the market has been quickly affected by the least sign of buying or selling pressure, which is only natural at the rather dangerously high level of prices. Fundamental conditions, however, have remained quite strong. The outlet for the manufacture of war munitions is certainly as big as ever, against which there is as yet no indication of freer supplies from the chief producing countries. War requirements in Allied countries, such as France, Italy, Japan, and Russia, being to a notable extent covered direct, this tends to restrict the tonnage diverted to home ports, and with America having but little to spare for shipment to this side, it is hardly likely that the big deficit in our imports so far this year as compared with last, will be made good for some time at any rate. The absence of a free market for the commodity due to the drastic action on the part of the authorities intended to restrict operations to bonâ-fide business, had at the same time proved a serious drawback for lead manufacturers. The latter, indeed, now find considerable difficulty to cover themselves by forward purchases against new forward contracts for their products. Dealers do not care to make forward sales which might be regarded as speculative and involve them under the Defence of the Realm Act. "Hedging" operations of this kind on the part of manufacturers are as a rule of frequent occurrence, but they are now almost impossible, so that trading in manufactured products is likewise suffering. After a renewed rise recently up to about £35 10s. for early shipment with a fair amount of business, the market just prior to the holidays reacted to well below £35, but there has been no great pressure to sell, although fair quantities of metal near at hand came on the market. There has been no material change in the American position, which remains firm, although prices have eased to well under 8 cents per lb., and the equivalent of prices realised in America continues pounds a ton above those ruling in this market. There has been very little American lead shipped to this side for some time past against old contracts. Operations in Mexico are virtually at a standstill, and the position in Spain is still anything but satisfactory.

GAS-FILLED RECTIFIERS.

In the *General Electric Review*, for April, an account is given of recent progress in connection with the hot-kathode argon gas-filled rectifier, by Mr. G. S. Meikle, of the Research Laboratory of the General Electric Co., U.S.A. The kenotron and the Coolidge X-ray tube, which have been described in the Electrical Review, employ the phenomenon of electronic emission, or "thermionic current," in bulbs from which all residual gases have been eliminated; in these high-vacuum types of apparatus the current is limited by the "space charge effect," of the nature of a back E.M.F., which is manifested by a drop of voltage in the kenotron, used as a rectifier, of the order of 100-150 volts, so that this device cannot be used on low-voltage circuits, though it is capable of supplying rectified currents up to 250 milliamperes at pressures up to 100,000 volts. The "space charge" is due to the electrons emitted from the hot kathode, which produce an electrostatic field around it which limits the motion of electrons towards the cold electrode; but in the presence of positive ions the space charge is more or less neutralised. By introducing minute traces of gas into the kenotron under certain conditions, a sufficient number of positive ions may be formed to neutralise the space charge completely, thus greatly reducing the voltage required to set up a given current. The nature of the gas is important; oxygen, whether free or combined, cuts down the emission of electrons from a pure tungsten kathode, but inert gases have no such effect. But with minute traces of gas present the positive ions acquire a very high velocity, and, striking the kathode, bring about its rapid disintegration. When the pressure of the gas is increased, the velocity of the ions is diminished, but their number is so much greater that the effect of their bombardment may be even more disastrous than with minute traces of gas present. Investigations covering a period of several years have revealed the conditions that must obtain in order to prevent kathode disintegration and other detrimental effects; by proper adjustment of the pressure of a suitable gas, disintegration has been eliminated, and it has also been found possible to secure conditions under which the emission of electrons from the kathode has been sufficient actually to cool it, when rectifying excessive currents. As a result of these investigations, in fact, it has been



Figs. 1 and 2.—Low-Current Rectifier.

Fig. 3.—High-Current Rectifier.

demonstrated that "a rectifier filled with gas at pressures within a more or less definite range can be designed to rectify currents from a few milliamperes to exceedingly high values, at voltages varying between several volts and several thousand volts."

Fig. 1 shows a sketch of a rectifier in which the kathode consists of a filament of small tungsten wire coiled into a closely wound spiral, and a tungsten anode of relatively large cross-section, with a comparatively smooth surface. The filament ends are welded to heavy tungsten wires, while the anode lead is swaged from, though still a part of, the anode. All leads are sealed directly through the high heat-resisting glass into 3-in. spherical bulbs of a similar glass. Although the anode of the tube shown consists of tungsten, other materials have been used with good results.

The rectifier shown in fig. 2 differs only in the shape of its parts. The kathode is shown as a straight filament of small tungsten wire, which, if properly proportioned and mounted, consumes a minimum of energy for a maximum number of electrons emitted. The anode is shown in the form of a thin disk, made large in diameter, to give a big radiating surface, which is found to be desirable when such metals as copper are used.

Fig. 3 illustrates a gas-filled rectifier designed to rectify high currents at low voltage. Two kathodes are shown; one is in filament form identical with that shown in figs. 1 and 2, and is used for starting; the other is a tungsten rod kathode with beaded tip (the middle rod), used during the operation of the tube. The constriction between the bead and the lead suffices to prevent conduction of heat from the tip. The object of using such a kathode is to secure a long operating life. Any disintegration, unless very severe, has no appreciable effect upon the life and operation of a rectifier of this design. A graphite anode mounted on a heavy tungsten lead is shown, as graphite has been found to be a very desirable anode material for rectifying high currents. All leads are sealed directly through the glass, and, for currents between 20 and 45 amperes, into a 5-in. spherical bulb.

All tubes are carefully exhausted and filled with gas in a high state of purity. Certain impurities, even though present in small quantities, produce a very rapid disintegration of the kathode, and also have a very marked effect upon the voltage characteristics of the rectifier. It is advisable in certain types of gas-filled rectifiers to introduce substances which react chemically with such impurities as are introduced with the gas, or are given off by the parts during the operation of the rectifier. The reaction which occurs keeps the gas in a pure state. It is found convenient in certain types of the low-current rectifier to introduce the purifying agent in the form of an anode. As the impurities are distilled from the anode or kathode, or from the over-heated glass parts, the arc drop increases. The increased energy consumption automatically causes evaporation of the anode material until the high state of purity is re-established, when the evaporation ceases. In figs. 1, 2, and 3, the purifying agent is shown as a coil wound around one of the leads.

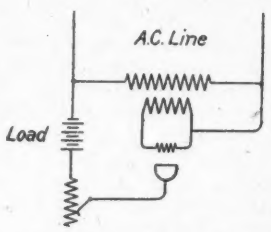


Fig. 4.—Connections of Half-Wave Rectifier.

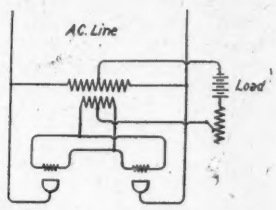


Fig. 5.—Two Half-Wave Rectifiers Connected to Rectify the Whole Wave.

During ageing it is evaporated, and re-deposits on the sides of the bulb, carrying with it the impurities in their respective chemical combinations.

The experimental work with argon indicates that rectification is possible in all pressures of gas. With an increase in the gas pressure the potential at which the arc is established increases. At the higher pressures, the temperature of the filament is also a factor in determining the starting voltage. After the arc is formed, the arc drop increases very gradually for big increases in gas pressures. For the low-voltage tubes a pressure of argon between 3 and 8 cm. (measured cold) gives very good results and is therefore used.

The half-wave type shown in figs. 1-3 has the advantages of simplicity of construction and installation. A typical circuit, consisting of a 40-watt transformer for filament excitation, a load, and a regulating resistance, is shown in fig. 4. If high efficiency is necessary, the line voltage is transformed to a value which enables regulation to be dispensed with. Two half-wave rectifiers can be connected as in fig. 5, thus using the whole of the alternating current; the compensating transformer is designed to transform the voltage to the desired value and to supply current for exciting the filament. Where the load can be divided, as in battery charging, the half-wave rectifiers with their individual loads can be connected up so that half of them are rectifying one loop of the wave, and the other half the other loop, thus attaining the same result.

Fig. 6 shows the full-wave gas-filled rectifier, with two anodes and a common kathode, which is used with the circuit shown in fig. 7.

The rectifier illustrated in figs. 1 and 2 has the advantage of being self-starting. In the low-current rectifier the kathode filament is excited continuously during operation, though the tube would continue to act as a rectifier when the arc was formed

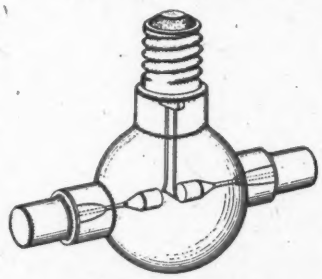


Fig. 6.—Full-Wave Rectifier.

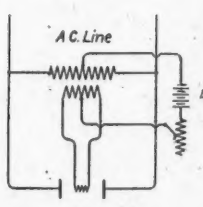


Fig. 7.—Connections of Full-Wave Rectifier.

without external excitation, the balance of advantage resting with the former method; in the high-current rectifier, however, the filament is used only for starting. A three-pole switch closes the filament circuit, and also connects it with the anode; the gas is immediately ionised, and current begins to flow to the operating kathode, which is acting temporarily as anode. When the latter

becomes hot enough to emit electrons, the rectifying arc is established between it and the anode. The tube can be made to start automatically by placing a D.C. relay in the rectified-current circuit, which opens the three-pole switch when the arc is formed.

When constant purity of the gas can be relied upon, the filament is used both as a starting and as an operating kathode, even in the high-current rectifier. Rectified currents as high as 80 amperes have been drawn from a tungsten filament 20 mils in diameter for short periods, without injury to it. But, in general, it is advisable to use the point kathode.

The persistency of ionisation in argon seems to be particularly marked, and this makes it possible even without filament excitation to use the rectifier for supplying current for very low frequencies. For the same reason, it is possible to operate the tube on very low current when the kathode is not externally excited.

No auxiliary starting load is required when beginning a battery charge. The supply switch is closed and the charging current picks up immediately, giving a slightly tapering charge as the battery voltage increases. On a resistance load, the current is very constant, due to the fact that the kathode spot does not wander.

The efficiency of the tube depends upon the supply voltage, increasing with it as the voltage become higher, and upon the energy consumed in the arc, indicated by the voltage drop. The arc drop of the low-current low-voltage rectifier, in which the filament is externally excited, is between 4 and 8 volts, measured on a direct-current circuit. The power consumed in keeping the filament kathode hot enough to produce initial ionisation is less than 40 watts. Therefore, for a 6-ampere tube the energy consumed by the arc and filament is equivalent to that of a rectifier having an arc drop of 10·66 to 14·66 volts. The actual drop in this tube without filament excitation is, however, somewhat higher than indicated by these values.

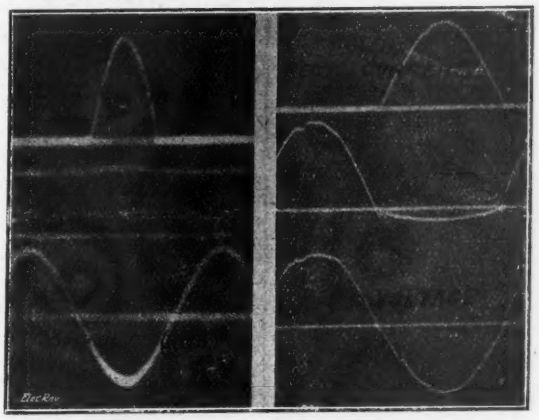


Fig. 8. Fig. 9.

Fig. 8.—Rectifier Charging Ignition Cells; 6·1 Amps.

Fig. 9.—Rectifier Containing Purifying Agent; 29·6 Amps.

The tube operates satisfactorily on currents ranging from a fraction to many amperes. With a properly excited kathode, the rectifying arc is started on alternating-current supply voltages as low as 20 volts and is maintained on voltages as low as 14 volts.

The life of the low-current low-voltage rectifier, upon which the greater part of the work has been done, varies from 900 to over 3,000 hours. Some of the high-current half-wave tubes have a life of over 1,000 hours, and many of 500 hours. Many of the low-current tubes have been in actual service for over 18 months charging batteries at central stations. In a case that is cited, a rectifier was charging 89 cells at 6·2 amperes; the D.C. voltage was 224 volts (average value) over the cells, and 236 volts (average) over the cells and regulating resistance; the A.C. voltage was 236 volts (root-mean-square value). A larger number of cells could have been charged by reducing the resistance to zero.

Fig. 8 shows oscillograms obtained from a rectifier charging a battery; the upper curve represents the rectified current (6·1 amperes D.C.), the middle curve the voltage across the battery terminals, and the lower curve the A.C. voltage. In fig. 9, from a rectifier containing an active purifying agent, the top curve represents the direct current (29·6 amperes), the middle curve the voltage across the arc (inverted), and the bottom curve the A.C. voltage. It will be seen that rectification in each case was perfect.

Magnetic Survey.—According to a telegram received by the U.S.A. Department of Terrestrial Magnetism, the *Carnegie*, under the command of Mr. J. P. Ault, arrived at Port Lyttelton, New Zealand, on April 1st, having successfully completed the circumnavigation of the globe between the parallels 55 degrees south and 60 degrees south. Errors in the existing magnetic charts to the extent of 12 to 16 degrees were found.—*Science*.

METER ERRORS IN PARALLEL SUPPLY OF FLUCTUATING LOADS.

Though complete electrification of factories and workshops, using central station supply, has become almost standard practice so far as concerns new installations, there are still a number of works in which such a considerable amount of mechanical driving equipment or electrical generating plant is installed and working with such high efficiency, that the problem of providing for further power requirements becomes one of special difficulty. On a simple basis of fuel and working costs, the central station engineer can generally show a material saving to the works' owner in purchased as compared with home-made electrical energy, but the question of capital cost of conversion is a serious item, particularly in a large works where the existing plant is still in good condition. It is easy to prove that extending the private generating plant would be poor policy in most cases, so that the only alternative to immediate and costly scrapping is to use purchased current for all extensions of load, and keep the existing plant working till analysis of costs shows that it would be cheaper to replace it by purchased energy.

During the intermediate period, when purchased current is being used to supplement home-made mechanical or electrical energy, the two sources of supply are connected in parallel—either electrically, by connecting the public and private mains to a common bus-bar; or mechanically by using, say, the private steam engine and an electric motor supplied from the public mains to drive a transmission system which is mechanically continuous. Under such circumstances the works would look after its own prime mover and generator (if any), and the central station would charge for supplementary energy supplied. In practically all cases this supplementary supply would be sold by meter on a sliding scale,

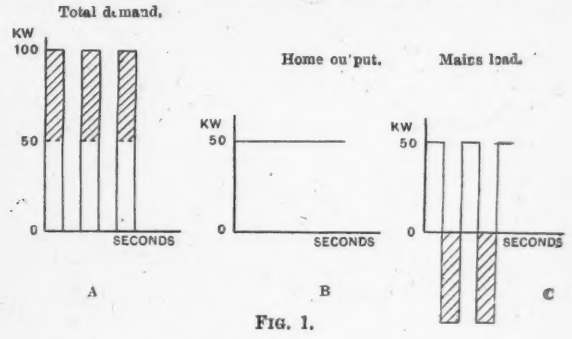


Fig. 1.

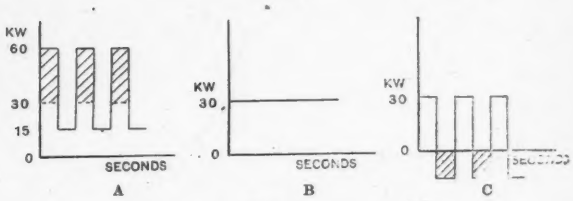


Fig. 2.

From mains, clear; to mains, shaded.

and it is important to note that the readings of a meter used under such circumstances are liable to be anything up to 100 per cent. slow, due to reverse running during low load when the load curve is very fluctuating.

On steady or reasonably steady loads the trouble does not arise, but if a rapidly fluctuating load is concerned (as in textile mills, particularly spinning mills) the private power plant runs at full output continuously; the central station supply is drawn upon during the peaks of the load-curve, and more or less of this amount of energy is returned during the troughs of the load curve. As an example (from a paper in *Elektrotech. u. Maschinenbau*), the two cases represented by figs. 1 and 2 may be considered. The left-hand diagram in each case represents the total demand to be supplied. In fig. 1A it amounts to 100 KW. for 1 second and zero for 1 second; if the output of the private generator be constant at 50 KW., the demand on the mains during one-half of the load cycle is replaced during the next half, so that the net meter reading is zero, and the works owner gets the benefit of peak load assistance for nothing. In fig. 2 the load varies periodically between 60 and 15 KW., and the private output is 30 KW. (constant), so that in this case the replacement is less than the withdrawal (see fig. 2C), but the meter still has a large negative error. The conditions in the two cases and the total deficiency in meter reading per hour of working under these load curves, are summarised in the following table:—

	Case (1).		Case (2).	
	Peak.	Trough.	Peak.	Trough.
Total load, KW.	100	0	60	15
Home generated, KW. ...	50	50	30	30
Taken from mains, KW....	50	—	30	—
Supplied to mains, KW....	—	50	—	15
Deficiency in meter record, units per hour... ...	25		7½	
Meter error, per cent. ...	100		50	

In general, if K_1 = power taken from the mains during the peak load; K_2 = power supply by private plant; and K_3 = minimum power demanded during the trough of the load curve; the meter record is actually—

$$w = K_1 \cdot t_1 - (K_2 - K_3) \cdot t_2$$

where t_1, t_2 = durations of peak and trough periods respectively. Hence, the percentage meter error is—

$$p = (1 - w/K_1 t_1) \times 100 \text{ per cent.}$$

One way of obviating error due to reversal in the above manner is to provide the meter with some form of locking gear which prevents the armature making more than one backward revolution, but even so it is possible to lose a great deal of revenue in the course of a year where the load fluctuates so rapidly, and one revolution of the meter disk corresponds to so much energy, that one revolution or less represents the energy drawn from the mains during one peak period, and returned more or less completely during the succeeding trough period. The best method of overcoming the difficulty is to provide such fly-wheel inertia in the plant to be driven that the peak demand from the mains is reduced, and the private generating equipment is kept busy on the load itself or in bringing the fly-wheels up to speed. The circuit conditions are equalised without troublesome equalising currents flowing.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"Mazda" Shade for Subdued Lighting.

The more stringent regulations lately enforced by the authorities as to the lessening of outward illumination from shops, offices and private residences have made it necessary for every individual lamp to be shaded. A neat and effective screen of attractive appearance is being issued by the British Thomson-Houston Co., Ltd., Mazda House, 77, Upper Thames Street, E.C., and any number in reason will be supplied to business firms, contractors, and retailers upon request. The shade is posted flat, and is made up of stout dark-coloured card, with stencil cut-out lettering backed by orange-tinted paper. The shade can be placed over any electric lamp without removing the latter, and if an ordinary fancy glass shade is used the "Mazda" shade will go over it. To place the screen in position, the two wings are locked together around the holder, this movement causing the shade itself to assume a curved form, thus shutting off the direct light rays from about one-third of the circumference of the lamp.

Timber-Piling Machine.

A portable electric machine for piling timber, patented by Mr. H. C. Hilke, is being made by the Seattle Machine Works, U.S.A. It consists of a lattice steel tower from 24 to 40 feet high, over which runs a continuous chain elevator, lifting planks on one side, carrying them over the top, and lowering them on the other side, where they are taken off at any desired height by the men building the pile. The chain is reversible, and the machine can equally well be used to unpile timber. It is stated that by use of this machine timber can be quickly piled at the lowest possible cost.

SUBSTITUTES FOR OIL IN HIGH-PRESSURE SWITCHGEAR.

Though the risk of oil switch explosions may be practically eliminated by proper design and construction, the use of inflammable liquid to quench a high-temperature flame can hardly be regarded as an ideal practice. There is a possibility also of fires which originate elsewhere than in the switch cases themselves being fed from oil in the latter. Provided nothing were sacrificed in electrical efficiency and safety, there would be a distinct field for a non-inflammable substitute for oil in high-pressure switch practice and about seven years ago E. Peyrusson (Paris) took out patents protecting the use of carbon tetrachloride in this connection. Nothing appears to have been done, however, till Voigt and Haeffner experimented with the use of that material in 1911, in ignorance it is said of Peyrusson's patent. The German experiments were revived in the summer of 1914, and conducted with special vigour after the outbreak of war, when there was a great scarcity of oil. The position is said to have been reversed a little later when oil became again available, and the raw materials for carbon tetrachloride, and the glycerine to protect it from evaporation, became scarce. Whatever the precise bearing of the matter on the question of Germany's supplies of material, the following notes from test data recently published in the *E.T.Z.* have an interest of their own.

Carbon-tetrachloride (CCl_4) or "benzinoform" is a colourless liquid of sp. gr. 1·6, which boils at 76½° C. and freezes at − 26·7° C. It evaporates as freely as benzine when exposed to the atmosphere, but it is incombustible and does not conduct electricity. The high sp. gr. of benzinoform (about 80 per cent. greater than that of switch oil) increases the difficulty of handling filled containers and necessitates heavier design of the latter. A more serious disadvantage is the great volatility of the tetrachloride. The level of liquid in an ordinary enclosed switchbox, filled with this material, falls 1 mm. per day by evaporation, and even after packing the joints as thoroughly as possible, the loss amounts to 0·5 mm. daily fall in level. Consideration of possible pressure rises inside the casing precludes sealing the case hermetically, and also renders a liquid seal inadequate. The use of a float is of little assistance, for though the exposed surface of the liquid is reduced, there is capillary creeping in the clearance between float and container. Peyrusson's patent suggested the use of a layer of glycerine or glycerine and water to prevent evaporation; this is satisfactory in its primary function, but if the switch-box be lowered for inspection of the switch, the latter becomes covered with a film of glycerine, which soon forms verdigris. Other troubles introduced by the use of glycerine are mentioned below.

Copper is practically unaffected by benzinoform at atmospheric temperature, but after prolonged immersion in the liquid warmed to 45° C., the metal is deeply corroded and covered by a greasy white layer. Aluminium, silver, and lead are less attacked, and tin is particularly immune, so that tinning gives satisfactory protection against chemical attack by CCl_4 except as regards hinges and contact surfaces, which cannot be permanently protected by a surface coating. Rubber, vulcanite, pertinax and micanite cannot be used in CCl_4, but fibre and mica are unaffected, and litharge cement, though blackened on the surface, does not lose its strength.

In respect of dielectric strength, the behaviour of benzinoform depends on whether the stress is momentary or sustained. The following data show the breakdown distance between pointed electrodes:—(A) For oil; (B) for CCl_4 and momentary stress, lasting 2 secs. or so; (C) for CCl_4 stressed for 20 minutes without breakdown:—

Test pressure between points.	Distance between points (mm.). (A) Oil.	(B) CCl_4 momentary.	(C) CCl_4 sustained.
10 KV.	6	—	9·5
30 "	12	—	20
50 "	20	—	33
60 "	26	12·5	42·5
80 "	41	36	66
100 "	62·5	59	—

The tests from which these data were obtained were made with CCl_4 which had already been used for short-circuit tests; though turned brown by this treatment the liquid had still good enough insulating properties to make it suitable for use in high-pressure switchgear. A switch designed on the basis of the figures in col. (C) above would obviously be able to withstand high surge pressures without breakdown. Probably the marked difference between the sustained and momentary dielectric strength of CCl_4 is due to the liquid being set into brisk motion by electrification; the movement is much more pronounced than in oil.

During the past 18 months various tests have been carried out on switches filled with CCl_4 and operated under various conditions of load and pressure. Limitations attached to the use of the "new" insulating material were soon discovered. Benzinoform evaporates so rapidly that the presence of a small leak in the container is not betrayed by visible staining or oozing, yet the loss of liquid may be so serious, that flash-over occurs through the reduced head of dielectric to the conducting "earthed" layer of glycerine, which alone affords effective protection against surface evaporation. It is not permissible to draw the switch out through the glycerine for routine inspection purposes, because the film of glycerine thus collected forms verdigris on the copper, and a conducting covering on the insulators; leakage across the latter then causes quantities of CCl_4 vapour to be driven off. Benzinoform does not possess the lubricating value of oil, hence it may be necessary to employ more powerful operating springs and solenoids, and presumably wear will occur more rapidly than in standard switchgear. The lack of lubrication is particularly undesirable when the switch has to break a short circuit, and should act as quickly and freely as possible.

The best form of switch for use with CCl_4 is the closed pattern in which the leading-in insulators are taken through the bottom of the switch, and the moving part passing through the glycerine layer is limited to a round rod. Accessibility for easy inspection must be sacrificed.

A mixture of 25 per cent. benzinoform, with 75 per cent. ordinary switch oil (by volume) loses only 5 per cent. in weight during 3 hours' heating to 100° C., and is thus much less volatile than pure CCl_4. The mixture is not incombustible, but is much less inflammable than oil. The small evaporation loss at 100° C. is evidence of the intimacy of the mixture, for the boiling point of pure CCl_4 is 76·5° C. The fact that the incombustible CCl_4 would distill off first in case of a switch fire might prove a point of practical importance, but the ultimate fire risk is obviously only reduced and not entirely eliminated. It is suggested by Vogelsang that some of the "incombustible" switch oils placed on the market have been simply mixtures of oil and benzinoform; as such they are not truly incombustible, but the characteristics of benzinoform afford good grounds for hoping that chemistry may yet evolve incombustible liquid dielectrics of high insulating value.

Though they may form the basis of more fruitful research, the data and information given above afford no ground for prophesying or recommending the use of benzinoform alone, or even in admixture, as a substitute for oil in switchgear. That its possibilities have been investigated at such length, at such a time, is probably another indication of Germany's difficulties and exigencies. Whatever future developments may be—and this field of research is certainly worth exploring—benzinoform as a substitute for switch oil may fairly be classed with iron and zinc as a substitute for copper conductors and with linoleum as a substitute for leather soles!

INSULATING OILS FOR TRANSFORMERS.*

Early in 1913 the Research Committee of the Institution of Electrical Engineers appointed a sub-committee to consider the properties of and methods of testing switch and transformer oils. Letters were sent to a number of manufacturers and users of oils, and to Universities, and the replies received were reviewed in an interim report by Mr. W. Pollard Digby in January, 1915. The Sub-Committee has considered the suggestions received with regard to the proposed tests, which in the first place are being limited to transformer oils. A brief account of the tests, most of which have been in practical use for some time, is given below. The points that now require investigation are :—

1. How far are the results consistent when made by different observers on the same sample of oil?

2. Could the results of the tests be relied upon to indicate with certainty the behaviour of the oil under practical working conditions?

The Institution has received a grant from the Advisory Council for Industrial Research for this work, and the Sub-Committee proposes therefore to put the experiments in hand at once, especially in view of the delays caused by the war.

The Sub-Committee expresses its indebtedness to Mr. Pollard Digby for the services rendered by him in examining the information received and drafting the first report, and to the small committee consisting of Messrs. A. R. Everest, A. C. Michie, and T. O. Thomsen who prepared the draft of the tests.

In order to judge the suitability of an oil for use as a cooling insulating medium, it is necessary to know its characteristics in the following respects :—Tendency to sludge; loss by evaporation; flash point; viscosity at different temperatures; chemical reactions; density and coefficient of expansion; cold test (solidification); moisture absorption; dielectric strength; specific resistance; thermal transference; and specific heat.

Sludging.—The object of this test is to obtain an idea of the tendency of the different oils to form solid deposits when they are subjected to the action of heat and air. This action is considerably influenced by the presence of certain metals. The method recommended is a modification of that used by Dr. Michie. The oil contained in a flask is subjected to the action of heat and oxygen for a given time, a piece of the metal in question of given surface area being present in the oil during the test. It would be of interest to obtain comparative figures for copper, iron, lead, tin, zinc, and aluminium, and, in view of the importance of copper in electrical work, data should also be obtained for tinned copper, silver-plated copper, and copper covered by insulating material such as cotton.

Besides the formation of solid deposits in the oils after these have been subjected to the conditions of the test, note should be made of any corrosive effects on the metals, the formation of water and acids, and the extent to which the oils have darkened in colour.

Loss by Evaporation.—Two different methods of carrying out this test are described. A definite volume of oil is heated in a beaker at 100 deg. C. for 8 hours. In one method the body of the beaker is immersed in the heating bath, its open mouth being exposed to the air of the laboratory but shielded from draughts. In the second method the beaker is carried in a revolving tray in a hot-air oven. The result is expressed in terms of loss of volume and ratio of surface to volume of oil, the height of beaker wall above oil surface at the commencement of the test being stated.

"Closed" Flashpoint.—The temperature at which vapours accumulating above the oil in a closed vessel become inflammable is determined by means of either the Pensky-Martens or Gray's instrument. The oil is rapidly heated to about 25 deg. C. below its suspected flash point, the heating being continued beyond this at the rate of 2½ to 3 deg. per minute. At each additional degree of temperature the cover is opened and a flame inserted. The lowest temperature at which flash occurs is thus determined.

Viscosity.—The standard method in Great Britain for this determination is that of Redwood, which notes the time in seconds required for a definite volume of oil to run through an aperature of fixed dimensions. Measurements are made at 15.5 deg. C., 50 deg. C., and 80 deg. C.

Chemical Reactions.—The oil is tested for acidity and alkalinity. An iodine test is also recommended, as it is believed that this test gives a good general indication of the tendency to sludge.

Density and Coefficient of Expansion.—The density is determined at the three temperatures 15.5 deg. C., 50 deg. C., and 80 deg. C., by means of specific gravity bottles or pyknometers, preferably of the Sprengel tube type. From these data the coefficient of expansion is obtained.

Cold Test.—This test determines the temperature at which the oil commences to congeal. A knowledge of this characteristic is of importance in connection with oil switches used in exposed situations and cold climates.

Moisture Absorption.—This test is made to determine the tendency of an oil to absorb moisture from the atmosphere, and is made by taking dielectric (breakdown) tests upon the originally dry oil after successive intervals of exposure.

Dielectric Strength and Specific Resistance.—These are familiar laboratory tests.

Thermal Transference.—A certain amount of information is available regarding the relative cooling effects in a transformer with oils of different viscosities, but it is felt that more exact information would be of value, and a method of investigation recommended by the National Physical Laboratory is described in detail.

Specific Heat.—The method of performing this test is left to the judgment of individual experimenters. Data should be obtained at 15.5 deg. C., 50 deg. C., and 80 deg. C. Reference is given to published data upon this subject. It is suggested that specific heat tests at 15.5 deg. C. might with advantage be made upon the oils both in their original condition and after drying, but for the test at higher temperatures dried oil should be employed.

Detailed methods of investigation for each characteristic recommended are given in the *Journal*.

* Abstracted from the *Journal* of the Institution of Electrical Engineers for April 1st, 1916.

AN ELECTROLYTIC OXYGEN AND HYDROGEN INSTALLATION.

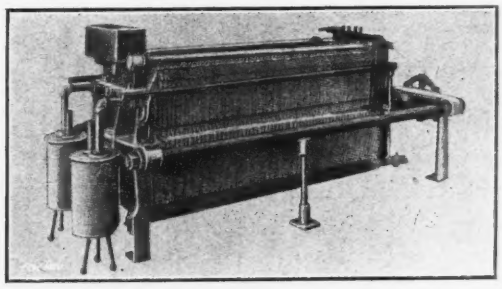
A new electrolytic oxygen and hydrogen plant recently put into operation at the works of the Fore River Shipbuilding Corporation, Quincy, Mass., is run entirely automatically, requiring the attention of only one man to a shift, the plant being run continuously by three men in three eight-hour shifts.

The plant consists of a crude-oil engine, belt-connected to a 45-kw. d.c. generator, and one of the National Ox-Hydric Co.'s electrolysers, as shown in the accompanying illustration, guaranteed to produce 3,500 cubic feet of oxygen per 24 hours and twice that amount of hydrogen.

The oxygen and hydrogen, after being produced from the electrolyser, pass into steel gasholders of 2,000 cu. ft. capacity each. From there they pass through a suction line into suitable compressors, which boost the pressure in the pipe lines between the gasholders and point of consumption to the amount required at the blowpipes. Between compressors and blowpipes or operating stations, are suitable concussion tanks to take the pulsation of the compressors off the pipe lines.

The plant is also equipped with high-pressure compressors, for the purpose of compressing oxygen and hydrogen into cylinders where it is not advantageous to run pipe lines, such as on board ships and other extreme points of the company's shipbuilding yards.

The National electrolyser is of the improved "filter-press" type. It consists mainly of a number of decomposition cham-



Filter-Press Electrolyser.

bers connected in series. These chambers are formed by clamping together a series of cast-iron electrodes, so recessed and grooved that each plate forms, with its neighbour, a chamber which holds the electrolyte, and in which the generation of the gases takes place.

The electrodes are carefully insulated one from the other by means of patented rubber-bound asbestos diaphragms. The electrodes and diaphragms are arranged alternately, and are supported by the insulated frame of the filter press. The required number of electrodes and diaphragms with the corresponding end plates are then pressed tightly together by means of a heavy screw standard, thus making the whole equipment form a hermetically sealed tank of the filter-press type, the diaphragms serving both as an insulation and gasket, and forming the sides of the cells, preventing any mixture of the two gases generated. The fact that the electrodes are thus separated by the diaphragms causes one side of the plate to act as the anode of the chamber and the other side as the cathode of the adjacent chamber.

The electrodes are composed of a special alloy, and are heavily coated with nickel, which makes them neutral to oxygen and alkali, and prevents the formation of deposits or the oxidisation of the electrodes themselves.

The number of chambers required is, of course, dependent upon the production of gases required, as well as the voltage of the electric current. The electrolysers of the National Ox-

Hydric Co. are designed for any standard D.C. circuit, or, with the use of a motor-generator set, for any of the standard A.C. circuits, thus doing away with the inefficient low voltage and high amperage necessary with the individual-cell type of installation. Furthermore, these electrolysers occupy about one-fifth the floor space required by the individual cell type.

By the design of electrode the anode and cathode are brought close together, so as to reduce to a minimum the electric resistance, while, at the same time, the hydrogen gas is effectually kept separate from the oxygen gas without preventing the proper passage of the electrolytic solution between the anode and the cathode.

The electrodes themselves are made with corrugated surfaces, increasing the active electrode surface and forming a large number of very small vertical channels through which the gases rise freely to the upper part of the plates. At the top of each electrode and hermetically sealed together are substantial chambers in which the gases are separated from the electrolyte. From these chambers the gases pass off in a dry state into ducts extending through each plate, these ducts forming continuous conduits, owing to the manner in which the plates are assembled. The gases pass through these conduits into their respective receivers or storage tanks. One of the main features of the design is the way in which the conduits are kept free from electrolyte; this is accomplished by a device which is cast integral with each plate, thereby eliminating any possibility of a short circuit even should the conduits become filled with the solution.

The electrolyte is a 21 per cent. solution of pure caustic potash in distilled water. After the electrolysers are once filled with this solution, distilled water is added from time to time to take the place of the water decomposed; the potash lasts many months. The distilled water is fed to the electrolyser by an automatic device which maintains a constant level of the electrolyte throughout the machine.

Under normal load conditions, the voltage required per cell is two volts or less. Therefore, to operate on a 110-volt circuit an electrolyser containing 55 cells is necessary; and on the same basis, 110 cells are necessary for a 220-volt circuit.

Assuming continuous operation and normal load conditions, the electrolysers yield 4 cu. ft. of oxygen and 8 cu. ft. of hydrogen at atmospheric pressure per KW.-hr. of energy consumed when the plant is operated at a temperature of 68 deg. F.

The gases produced are very pure, the oxygen being of 99.5 per cent. purity. The electrolyser will stand an overload of 50 per cent. without any ill effects. This feature of being able to overload the plant and generate a proportionately greater amount of gas is of great advantage.

The water of which the electrolyte is formed has to be distilled in large commercial plants, but in the smaller individual plants the purchase of distilled water in quantities sufficient to operate the plant is advocated.

The electrodes are said to be practically indestructible. The asbestos diaphragms are very durable, and, being neutral to the elements with which they come in contact, have a life fully equal to that of the electrodes. All other parts of the equipment are practically not subject to any wear and tear.—*Metallurgical and Chemical Engineering.*

DIESEL ENGINE USERS' ASSOCIATION.

At the April meeting of the Association, the accident to an air compressor attached to a Diesel engine at the Smithfield Markets was further discussed. Mr. W. Fennell suggested that it might be advantageous to fit some suitable form of coil instead of the usual purge pot.

Mr. R. Lyle referred to an accident of a similar nature which had occurred on an air compressor attached to a 300-B.H.P. Diesel engine at the works of the Hoffmann Manufacturing Co., Ltd., in 1913. On that occasion, fortunately, no personal injuries resulted from the accident. The engine had been at work continuously for 24 hours before the accident occurred, whereas, in the Smithfield case, the accident occurred on starting the engine. It was found that the H.P. suction and delivery valves of the compressor were somewhat worn and fouled with carbon deposit. An exhaustive inquiry was held, but no very definite conclusion was arrived at. It was suggested that the bursting of the purge pot was caused either by the high pressure getting back from the blast vessel or being built up, or by high pressure due to the combustion or explosion of oil vapour. Mr. Lyle did not think that the first theory was tenable, as the calculated bursting pressure of the purge pot was over 2,000 lb. per sq. in., and the pressure in the blast vessel did not exceed 850 lb. at the time of the accident; the necessary pressure could not be built up, as a test by the makers, which consisted in blanking-off the delivery pipe and running the compressor up to full speed, proved that the relief valves dealt efficiently with the air. He considered that the trouble was undoubtedly caused by explosion, brought about by high terminal pressure and temperature in the intermediate-pressure cylinder, which might have been caused by the H.P. valves sticking up, as was suggested in the case of the Smithfield accident. There was, however, another probable cause of the accident which his experience suggested. He had been able to satisfy himself that one cause of a rise in temperature in the I.P. purge pot was from a choking of the I.P. cooling coil, due to a carbon deposit taking place at the sharp gunmetal bend which coupled the I.P. delivery pipe to the cylinder. This might lead to the generation of an ignition pressure and temperature at this particular spot, and this pressure *would not be recorded by a gauge on the* I.P. *purge pot.* The precautionary measures taken as a result of the accident were as follows: A check valve was fitted on the H.P. delivery pipe as close as possible to the air compressor casing; pressure gauges were fitted to the I.P. and L.P. stages, so as to give timely warning when the valves needed attention; instructions were given for the valves to be cleaned at more frequent intervals, and it was recommended that this should be done every six weeks, but the experience gained by a study of the gauge pressures would be the best guide; the valves also should be renewed before any play or rounded seatings became accentuated.

Referring to Mr. P. H. Smith's recommendations in connection with the Smithfield accident, Mr. Lyle stated that his experience led him to suggest that the provision of anti-vibrators in connection with the gauges was better than throttle valves, as being more reliable in damping the oscillations and in providing freedom from choking. He considered that large relief valves provided no proper safeguard against explosions, though he quite agreed that valve wings choked the area. He thought that a non-return valve should certainly be fitted between the H.P. delivery and the blast bottle. With regard to Mr. P. H. Smith's statement that the L.P. purge pot was always the hotter when the machine was in good order, Mr. Lyle contended that this would depend on the type of the compressor, and that when fitted with the L.P. condenser type of cooler the reverse would be the case.

Mr. P. H. Smith desired to make a correction in connection with the remark in recommendation (6) in his report by adding the words, "this remark applies only to compressors in which cooling coils are used, and not multitubular coolers."

The next meeting of the Association will be held on Wednesday, May 10th.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

"Glow Lamps."

In the recent new wiring regulations of the Institution of Electrical Engineers, the Institution Committee adopts the term "glow lamps" to refer to incandescent electric lamps.

It is of interest to note that this term does not appear to be used at present by any of the electric lamp manufacturers in their lists as a descriptive term for the electric incandescent lamp. Examination of over 100 lamp catalogues issued by electric lamp manufacturers for a long period only traces the use of the expression "glow lamps" in one of them.

A. B. C.

Electricity in War Areas.

It is with great pleasure that one receives out here regularly a copy of the Electrical Review, kindly sent by the editors and publishers, which enables one to keep in touch with what is happening in electrical spheres at home and abroad.

It may be of some interest to your readers to hear that electricity is playing an important part on this front; one finds where power is available from company mains that full advantage is taken of it in every possible way, and it is truly painful to see the thousands of pounds' worth of up-to-date electrical plant, *i.e.*, large capacity sub-stations, transmission lines, transformers, &c., lying about in the "unhealthy area," rendered useless either by shell fire or exposure to the bad weather one has had to contend with in recent weeks.

One wonders if the orders after the war for reconstruction, new installations, &c., will be placed at home, as undoubtedly a huge volume of business is bound to be obtained out here.

One interesting application of electricity is, perhaps, worth mentioning. A certain mobile workshop near the line was equipped with a dynamo coupled to an internal-combustion set, but it was discovered that an old flour mill, dating back from 1787, possessed an overshot wheel, driven from a small stream near by, and shafting (incidentally, the drive was bevel wheel and pinion with wooden renewable teeth). This has now been utilised as prime mover, a countershaft obtained from a "shelled" thrashing machine fitted up, and the dynamo is now driven by water-power, an improvised transmission line being run to the workshop supplying power and lighting, and, consequently, saving valuable liquid fuel.

Previously, in another part of the front, the same dynamo was taken off its engine bed and coupled to a 3-phase motor that happened to have lost its owner, and connected to com-

pany mains, the insulators of the transmission lines in this case being the tops of champagne bottles, filled with plaster of Paris.

One wonders what will be the next vicissitude the dynamo will pass through.

A.M.I.Mech.E., A.M.I.E.E.

B.E.F., France.

The Resistance of a Cubic Frame of Wire.

The solution of this question has provoked considerable discussion, and Dr. Fleming has given the general form of solution for such mesh questions, involving a set of simultaneous equations, and their solution by determinants. This is, doubtless, the correct general method, but a good many engineers have little familiarity with determinants, and it may be worth while to show a very simple way of treating the particular case.

Fig. 1 shows the cube framework in perspective, with the 12 wires numbered. Fig. 2 shows these wires developed by following the three paths from one angle of the cube to that opposite. It is at once obvious that these paths form two terminal sections each of three wires in parallel, and a central section of six wires in parallel. The resistance of the three

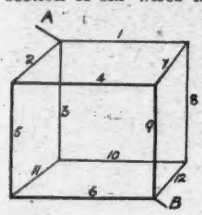


Fig. 1.

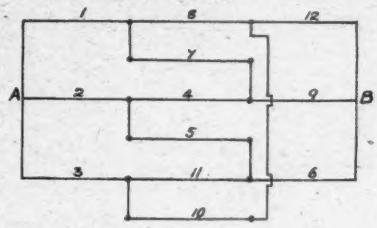


Fig. 2.

sections in series is, therefore, 1/3 + 1/6 + 1/3 = 5/6 of the resistance of one wire, assumed all equal as in the question. The vertical connections represent the junctions of the wires at the angles of the cube, and are of zero resistance. The method seems to be applicable to any mesh arrangement, but it may obviously involve complex arithmetic where the mesh sides are of different resistances and otherwise complicated.

Henry M. Sayers.

London, S.W., *April 16th*, 1916.

WAR ITEMS.

Exemption Applications.—At the Lambeth Tribunal an application for exemption was made by an electrician employed by the South Metropolitan Electric Supply Company, Ltd. As an outside worker it was a moot point as to whether he was in the revised list of reserved occupations. His grounds for exemption were that he was in a "reserved occupation, and that he was employed on public utility service." The case was adjourned for the appearance of the applicant's departmental manager, who later informed the tribunal that the man was exempt. He had that morning had a letter from the Minister of Munitions declaring that the men previously exempt as far as public electric lighting companies were concerned, were still exempt. The Mayor said they would adjourn the matter for inquiry. These exempt men ought to have badges and certificates, and the tribunal should not be burdened with their appeals.

At Stratford-on-Avon, on April 12th, the manager of the electricity works claimed exemption for Mr. H. L. Smith, electrician, on the ground that it was expedient in the national interest that he should remain in his present occupation of installation work. Two months were allowed to find a substitute.

In applying at the Sunderland Tribunal for the exemption of a journeyman electrician, a firm of electrical engineers said they considered him indispensable to the town because of his expert knowledge of X-ray and other surgical apparatus, and because he was often engaged in repair work at the Royal Infirmary and other hospitals in the district. There was no one else in the firm who could do such skilled work. Conditional exemption was granted.

At Richmond-on-Thames, on April 15th, the Richmond Electric Supply Co., Ltd., applied for exemption for an assistant in the showroom, it being claimed that the occupation was a reserved one. The tribunal decided otherwise, and refused the appeal.

At the Durham County Appeal Tribunal, last week, application was made by the Imperial Tramways Co., Ltd., for the exemption, on the ground of indispensability, of two fitters employed at Stockton-on-Tees. Both were single, and had been granted temporary exemptions. It was stated that the men were essential for the proper working of the company's system, which was the means of transit of munition workers. It was absolutely essential that the cars should be kept in perfect order. At the beginning of the war, the company had 16 fitters, and this number had been reduced to eight. It was stated further that a representative of the Ministry of Munitions had recently visited the works, and had had to admit that in his search there for men who could be spared, he had drawn blank. The elder man applied for was granted exemption until August, when, it was pointed out, it would be open to the firm to make a further application. The appeal in regard to the younger man failed.

Before the East Kent Appeal Court, on April 14th, Mr. Joseph Iggulden, electrical engineer, of Folkestone, appealed against refusal of exemption by the local tribunal. The Court decided that the latter body should grant three months' exemption.

Dartford Light Railway Co. have applied for exemption for 12 motor men, a driver, repairer and fitter, a driver and mechanic, a car and overhead equipment repairer, a driver and traffic inspector, and a brake fitter and overhaul repairer. All the rest of the employés are over military age. Conditional exemption was given to each, with a time limit of six months to those not married.

At Lewes, the Electric Supply Co. applied for absolute exemption for an engine fitter and cable jointer, and the request was complied with. Conditional exemption was also allowed the company's clerk.

The Surrey Appeal Court has refused an appeal for exemption made by Mr. E. B. Slaughter, electrical engineer, of Haslemere.

At Rugby, Mr. Hosking, assistant works manager to the British Thomson-Houston Co., Ltd., appealed for exemption for six engineers, two of whom completed their college course on March 31st, and the other four would do so on July 31st. The military recommended no exemption for two from a college in Scotland, who had finished their theoretical training, and exemption until July 31st to the four from English colleges, to enable them to complete their course of studies. Mr. Hosking said they were not pupils, but testers, who wished to come to Rugby to do practical work, and to be trained as electrical engineers. Before the war they had 94 testers, they had lost 55, and at present had 42 English testers and 12 of other nationalities. In testing it was absolutely impossible to dilute with female labour. The military recommendation was agreed to, and Mr. Hosking said he should appeal.

At Malmesbury, Mr. B. de Bertodano applied for temporary exemption for Richard Bishop, who runs an electric plant serving Cowbridge House. Exemption until July 15th was granted.

At Basingstoke, exemption was sought for an electrical wireman, engaged in the electrical installation at Park Preweth Asylum by Messrs. Hill, Upton & Co. The firm's manager said that their work was under the direction of the War Office, as the new asylum might be used as a military hospital. Exemption was allowed until May 15th for applicant to have his certificate as a voluntary munitions worker renewed.

At Bacup, last week, the secretary and manager of the Corporation electricity department appealed for the exemption of a fitter's labourer. It was submitted that this was a certified occupation, that there was pressing work in hand in connection with the sub-station for special purposes, and that it would take considerable time to train another man. The military representative said there was nothing in the lists or instructions which entitled the appeal to succeed. The appeal was disallowed.

The Austrian Electrical Industry in War Time.—A communication on this subject was recently published in the "E.T.Z." from E. Honigmann, of Vienna, who, after giving a survey of the situation from the time of the outbreak of the war, states that the electrical industry quickly recovered in the early months from the inevitable reactions which occurred at the beginning of the war, and accommodated itself to the new state of affairs. By way of illustration of this fact, it is mentioned that the companies which are liable to make a public return of their accounts, although not able to distribute such good dividends as in normal times, were yet able to divide acceptable profits for 1914 despite the large provision made for reserve funds and the exercise of great prudence in the preparation of the balance sheets. It is probable that the results for 1915 will show an improvement, as the turnover of those firms who produce articles for army requirements experienced a considerable increase, whilst at the same time yielding better results owing to the cessation of the keen competition which formerly took place. Other factors in the situation are that the old stocks, including those which had been partly or entirely written off long ago, were disposed of at good prices, that manufacturing has been simplified, that the production of munitions which caused many difficulties at first became profitable with the growing experience of the workmen and the increase in the output, and that a large portion of the working expenses declined.

The electricity works within whose scope of supply are situated works which are engaged on army contracts, also earned a larger income, not only on account of an expansion in the demand on the part of old customers, but also because of the addition of many new connections, as numerous owners of private installations preferred to obtain a supply from central stations, owing to the dearness, or difficulty of procuring, coal or liquid fuel for their own individual plant. Thus, for instance, the company owning the

great station at Rossitz was compelled to install a large new generating set in order to meet the greater demand for energy. After the re-conquest of the Galician oil yielding region provisionally occupied by the Russians the difficulties experienced by the owners of oil-engined installations were probably overcome, but the price of crude oil is still so high that it is more profitable to have a connection with a generating station. As to the question of a scarcity of raw materials, the author remarks that the Austrians helped themselves in the same way as the Germans by the adoption of substitutes, as, for instance, iron and zinc for conductors, paper insulation, &c.

It is submitted that an expressed dearth of raw materials has probably not yet been perceived. Nevertheless it is contended that precautions should now be taken, so that on the conclusion of peace the replacement of exhausted stocks should not be left to the action of individuals, as this would lead to the forcing up of prices by speculators and the causing of immeasurable damage to the industry. The work of acquiring raw materials should be carried out according to a scheme of centralisation under Government control, under which the materials would be grouped together.

American Engineers and Preparedness.—At a special meeting in New York on March 20th, attended by 3,000 engineers, the following resolutions were adopted:—

"The engineers assembled in public meeting on March 20th, 1916, under the auspices of the Engineers' Committee on Military Lectures, believe that it is unworthy a great nation like the United States, and that it is dangerous to the peace, safety and liberty of its people, to remain in our present position of inadequate military, naval and industrial preparedness.

"We believe that between pacifism and militarism there is a just, safe and proper ground, greatly in advance of our present position—a ground which involves large additions to both the navy and army, a large increase in our schools for training officers and a co-operation and mobilisation of the physical and industrial resources of the nation.

"We believe that this nation should never make war except to enforce peace; that when strongly supported by armed resources its influence in maintaining its own liberties and rights, and the liberties and rights of the weak and oppressed throughout the Americas, will be greatly strengthened.

"We believe that Congress should give due weight to the opinion of experts and should then appropriate sufficient money to put the nation in a position of defence against attack on either the Atlantic or the Pacific Coast.

"We demand that our representatives in Congress act in accordance with this expression."

Many prominent electrical engineers were among those subscribing to the resolutions.—"Electrical Review and Western Electrician."

Made in Holland.—The "Auckland Weekly News" refers to complaints that are being made by New Zealand importing firms that although direct trade with German factories is blocked by present conditions, a large amount of business that will ultimately accrue to the benefit of the German firms, is still being done in New Zealand, especially in electrical requisites. One dealer attributes the cause of the trouble to the fact that a large number of Anglo-German businesses, with works in England, are in the hands of supervisors, but their goods are going out to New Zealand in competition with the manufactures of Britain and her Allies and of neutral countries. He asks: "Why should enemy enterprises be allowed, under this thin disguise, to keep open the market in the Dominion, so that purely German business may step in at the close of the war and reap the benefit of this warming pan system, as if their trade had never suffered interruption?" The "News" later refers to the question of electric lamp manufacturing thus:—"As a striking illustration of the flimsy pretexts on which enemy trade is permitted, the trader produced a certificate covering a small consignment of a particular kind of electric lamp, manufactured in Holland. He had received a circular advertising the line and had sent a small order to see what he might discover. Sure enough, with the goods came a certificate from the British pro-Consul in Rotterdam to the effect that the Dutch company had satisfied him that the goods had not been manufactured in enemy territory, and that they 'did not contain materials or labour of enemy origin to a value exceeding 17 per cent.' So that, it was pointed out, £17 out of £100 of the value of the goods in Holland admittedly went to assist the enemy. The lamps in question, it is stated, are being sold in New Zealand by thousands."

Trade After the War.—Mr. Asquith was recently asked in the Commons whether any, and if so what, steps were being taken by the Government to formulate a trade policy after the war. In reply, according to the "Times," he said that a committee of the Cabinet was appointed some time ago to deal generally with all questions of reconstruction—including those relating to commercial and industrial policy—which were likely to arise at the close of the war. The detailed investigation of particular aspects of the problem would be carried on by sub-committees, as to the most important of which the Cabinet were in communication with the Dominions.

Dilution of Labour.—In reply to a Member of the House of Commons who asked the Minister of Munitions to what extent his demand for 80,000 skilled and 200,000 unskilled workers had been met, Dr. Addison said that the effect given to the policy of dilution, that was, the performance by women or unskilled men of work hitherto performed by skilled men, had enabled the demands for skilled men to be largely met. The demands for skilled men which could not be filled by the employment of women or unskilled men had been partly satisfied by the transfer of war munition volunteers from private work, the release of skilled men from the Colours, the introduction of labour from the Dominions, and from certain foreign countries, and by training semi-skilled persons or persons skilled in trades similar to these in which vacancies existed. There was still, however, a large demand for skilled men. This was especially important in shipyards, and the demand could only be met by the further progress of the methods referred to, and particularly by further dilution. The demand for unskilled workers had been largely reduced, mainly by the introduction of women.—"Morning Post."

Post Office Tube.—According to the "Daily Telegraph," the suggestion has been made by Colonel Norton-Griffiths that the work of the Post Office Tube Railway should be suspended so as to release the large number of men employed for pioneer battalions and other Royal Engineer units, where they are urgently wanted. Though the Postmaster-General stated that it would not be expedient to suspend such work, he was considering, in conjunction with the Ministry of Munitions, whether it would not be advisable to divert some of the men now employed on the tunnel.

Exports to China.—The "London Gazette" for April 18th and 21st contains further lists of firms and persons in China and Siam to whom exports may be consigned.

LEGAL.

Electric Battery Contract.

An action by Pritchett & Gold & Electrical Power Storage Co., Ltd., manufacturers of electrical batteries, against Hamble, River. Luke and Co., Ltd., Hamble, Hampshire, was heard by Mr. Justice Sargant, in the Chancery Division, on April 17th.

Mrs. Hilda Beatrice Currie, of Upham House, Aldbourne, Wiltshire, was originally a defendant to the action, but, as counsel explained, she interpleaded, and an order was made whereby she paid into Court £255 odd, and withdrew from the action, her costs having to be provided for by the Judge. The action now came on between the plaintiff company and the defendant company.

Mr. Grant, K.C., who appeared for the plaintiffs with Mr. Merlin, said the claim was for payment of the price of a contract for the supply and erection of an electrical installation at Mrs. Currie's premises. The main contract was between her and the defendant company. The plaintiffs were sub-contractors to the defendant contractors. The contract was dated February 14th, 1914, and was for a general electrical installation for the purpose of lighting, pumping water in case of fire, and telephonic communication within the house, garage and engine room at Upham. The price for the whole of the work was £1,363. Defendants wanted to sub-contract for the battery—a 66-cell one—and the plaintiffs were to supply it and put it into working order, and start it off for £286. Plaintiffs delivered the material in a large number of cases ready for erection, but before the erection the defendant company went bankrupt. They, however, took the materials supplied by the plaintiffs, and did the erection, and now they said that the property in the goods passed to them when the plaintiffs delivered the materials, notwithstanding that the contract was not completed. They declined to pay the contract price, and said the plaintiffs would have to take whatever dividend the company could pay. Plaintiffs, on the other hand, said they had a contract for the supply of the materials for the battery, and they were to put it up and start it off, and until that contract was completed on the premises, no property passed in any portion of the goods. Counsel argued that this was one contract, not for the sale of goods at all, but for materials to be supplied and work to be done in the erection of the battery, coupled with the superintendence of the first charge.

His Lordship: You say it was a contract for the supply of a battery in working order?

Mr. Grant: That is so.

Mr. Romer, K.C., who appeared with Mr. H. E. Wright for the defendants, said the plaintiffs made default to erect the battery, and the defendants did it.

The hearing was continued on April 18th.

Mr. Romer, K.C., who appeared with Mr. H. G. Wright for the defendants, argued that the plaintiffs had tendered for a battery, and had not incurred the responsibility of erecting it. This was not a case analogous to that of a man contracting to build a motor car on a buyer's premises; it was a contract to supply the component parts of a battery, and the moment the articles were delivered the property passed from the plaintiffs to the defendants.

Mr. Grant, K.C., said in reply that there was no completed contract until the battery was erected.

His Lordship, giving judgment, said the real question was

when did the property in the goods pass. If the property in the materials for the battery passed to the defendants, as was alleged, at or about the time of the delivery of the materials, free on rail for the railway destination, then of course the plaintiff company were only entitled to prove in the liquidation for the amount due to them. If, on the other hand, the property in the materials did not pass, then the plaintiffs were entitled to the materials, and under the arrangement made by the order of the Master, to have paid out to them the sum paid into Court by Mrs. Currie. In his judgment all the difference was made by the special terms of the actual contract between the parties which seemed to him, on their true interpretation, to amount to a contract for the sale and purchase of a battery as one complete and entire whole *in situ* and in working order with its first charge included. The legal consequences were that the property still remained in their original owners, the plaintiff company, and they were entitled to have paid out to them the sum paid into Court and to have the costs of the action against the defendant company.

A stay was granted with a view to an appeal.

Cedes Electric Traction, Ltd

Upon the petition of the Tudor Accumulators, Ltd., Mr. Justice Neville, on April 18th, made an order for the compulsory winding up of this company. The matter had been standing over for some time, and counsel for the respondent company said he could now no longer resist the order.

The Kingstown Electric Lighting Scheme.

The Irish Court of Appeal delivered a considered judgment in the appeal by the Dublin Southern District Electric Supply Co., Ltd., from the decision of Mr. Justice Barton in the matter of the arbitration between the company and the Kingstown Urban District Council, refusing an application made by the company for an order directing the Taxing-Master to tax the costs of the company as against the Council, in the proceedings in connection with the scheme for the electric lighting of Kingstown, on the scale provided by the Acts for the taxation of Parliamentary costs, or, in the alternative, that the costs should be taxed as Chancery costs on the higher scale as between solicitor and client, or for such order as the Court might think reasonable. Their Lordships had previously dismissed the appeal.

The Lord Chancellor now pointed out that, in making his award, the arbitrator, Mr. S. L. Brown, K.C., did not use the word "expenses," or refer to expenses by name. On looking at the schedule to ascertain what it was that was made a rule of Court, no submission in the ordinary sense could be found. The Arbitration Act of 1889 did not apply to Ireland, and if the matter had been amply dealt with by statutory provision, it did not apply to that country. They were confined to the provisions of the Common Law Procedure Act and the older statute of William III, dealing with arbitration. It did not appear that the immense difficulty raised by that simple consideration was brought before Mr. Justice Barton, and the trouble that he (the Lord Chancellor) found, was that the company, of necessity, having obtained the order which made the presumed submission a rule of Court, could not themselves argue or suggest that the proceedings were now irregular. Nor could the other side do it, because they were content to have the order made, so far as the award generally was concerned, which, he believed, had been obeyed. The award was afterwards confirmed. It was a very serious question whether, in view of what appeared to be a defect on the face of the proceedings, they should base their decision on that state of affairs. The whole point turned on whether there was any award on the word "expenses" in Sec. 28; this conclusion was that if that section was to apply, as he was willing to consider it, it covered something to be paid by one party to the other and was really only costs; that it included costs, and that where it was a larger thing than costs, and where the expression was interchangeable with costs, the arbitrator had jurisdiction to make the order which he did, giving costs simpliciter. It was impossible not to see that a grave and serious question arose as to whether the whole proceedings in the case were not outside jurisdiction. He thought, however, on the whole, as he found an order purporting to be regular, which might be within jurisdiction if there was a real submission, he might safely declare his opinion that Mr. Justice Barton's view was correct.

Lord Justice Molony and Lord Justice Ronan concurred.

The Lord Chancellor said Parliamentary costs would be, of course, indemnifying costs, his view being that the decision of the Court of Appeal in England in Peterson's case was conclusive on the subject. He also pointed out, with regard to the extension of the Arbitration Act to Ireland, that three lines would have cured what was a very manifest error.

Mr. T. M. Healy, K.C., M.P. (for the company) said it might interest the Court to know that when a clause was being drafted the Board of Trade ruled it out.

In reply to Mr. Clancy, K.C., M.P. (for the Council), the Lord Chancellor said the ruling was that the appeal was dismissed, with costs.

S. T. Baldry *v.* Sun Electrical Co., Ltd.

Judge Parry, at the Lambeth County Court, on 20th inst., gave judgment in the application for compensation made by Samuel Theodore Baldry, aged 14 years, who, through his father, Joseph William Baldry, engineer, of 65, Kirkwood Road, Peckham, brought an action under the Workmen's Compensation Act against the lad's employers, the Sun Electrical Co., Ltd., of 118-120, Charing Cross Road, W. The facts were reported in our issue of April 7th, page 391. A piece of metal thrown by another boy caught the applicant in the right eye, the sight of which he lost. His Honour, in giving a considered judgment, said a suggestion was made that the boys were larking, but their evidence convinced him that this was not so. They were taking an intelligent interest in their surroundings, and seeking information from each other, as human children of their age would do, and, according to modern educationalists, should be encouraged to do so. He had no doubt that this was an accident arising out of, and in course of, the applicant's employment, and made an award in his favour of half wages of 9s. 10d. a week since the date of the accident, with costs.

Morgan James *v.* Bedwellty District Council.

Mr. Justice Astbury, in the Chancery Division, last week, gave judgment in the action of Morgan James, flannel manufacturer, Maesycymmer, against the Bedwellty District Council. The matter is reported in the *South Wales Echo*, which says that plaintiff sought damages for the pollution of the river Rhymney with sewage, which, it was alleged, clogged plaintiff's turbine to such an extent, that it would not work, and, as the consequence, plaintiff had to obtain electric power and light for his factory and house from the South Wales Electric Supply Co. at considerable expense. Defendants denied liability, and pleaded that the machinery could not work owing to its neglect and defective erection.

His Lordship said there was only one fact not disputed, and that was that the Council poured their undiluted sewage into the river. Not unnaturally, perhaps, defendants sought to throw the blame on the other District Councils, particularly the Council of Gelligaer. On the evidence, he thought there were three contributory causes to the loss of the power of the turbine. The first was that the plaintiff neglected to replace worn blocks; the second was that the vanes of the turbine were choked with solid sewage matter mixed with coal dust, and the third was that, owing to the presence of sewage, the screens to the turbine became unusable. The parties, and especially the defendants, had spared no expense in presenting the case. Balancing the evidence as best he could, and notwithstanding the expert views which were very positively given by the defendants' witnesses, he had come to the conclusion that solid sewage did find its way from defendants' pipes to plaintiff's factory, and that even if plaintiff had kept his turbine in proper repair, it could not have given satisfactory power. He awarded plaintiff damages for £150 and costs, and refused a stay of execution, remarking that he thought the Council had indulged themselves very freely in incurring expenses for expert evidence.

Munitions Cases.

Before the Oldham Munitions Tribunal two Belgians applied for leaving certificates to enable them to leave the service of an electrical manufacturing firm. They complained that they felt ill and said they desired to go to London for a rest and to undergo medical treatment. A doctor's certificate was produced showing that both men needed a rest. It now transpired that one of the men did not want to go to London, but wished to take up textile employment at Bradford, having been offered a wage of £4 per week. Spinning, according to the doctor, would suit him better than shell-work, which was too heavy for him. The men said they received 28s. and 32s. per week respectively, with 3s. war bonus in each case, but according to the statement of a representative of the firm their average earnings were 47s. per week and 37s. 8d. per week respectively. The applications were refused.

At a General Munitions Tribunal at Oldham, an electrical firm complained that the Gordon Spinning Co., of Hollinwood, had engaged a junior clerk from their office without consent or leaving certificate. Mr. Marland, of the electrical firm, described the youth's work and strongly complained about outside firms taking their clerks after they had trained them. At least a dozen boys from their place had been taken into cotton mills during the last few weeks. Mr. A. J. Ashton, K.C. (President), said they did not intend to allow textile companies to go on taking these boys as they had been doing. They were going to protect the munitions establishments as much as they could. There would be a fine of £2 in this case, but it must be clearly understood that if offenders came again, either in Oldham or in other towns, they would take a severe view of the matter. Mr. Pickford, manager of the Gordon Co., said he was sorry if he had acted wrongly, but he had done it in ignorance. The President said he was prepared to accept that statement. If he had thought the act had been committed other than in ignorance he would have imposed a fine of £10 or £15.

Trade with Australia.—H.M. Trade Commissioner for Australia (Mr. G. T. Milne) is about to visit those trade and industrial centres in the provinces which have been decided upon as most advantageous to visit in view of the applications that have been received from firms in or near those centres, and from Chambers of Commerce. The itinerary of H.M. Trade Commissioner's tour includes Bristol, Newport (Mon.), Cardiff, Birmingham, Wolverhampton, Walsall, Coventry, Leicester, Nottingham, Derby, Stoke-on-Trent, Dublin, Liverpool, Manchester, Sheffield, Huddersfield, Bradford, Leeds, Newcastle, Edinburgh, Dundee Dunfermline and Glasgow in the order named.

BUSINESS NOTES.

Greece.—The French Consul-General at Athens gives the following particulars regarding the commercial situation in Greece as far as concerns imports. Price, owing to the competition of German and Austro-Hungarian products, is an essential factor, and should be fixed at the lowest level practicable, and should embrace freight, insurance and packing. Among wares which French exporters might offer with a good chance of sales are lighting apparatus, chemical products, machinery, dynamos, steam-engines, &c. The Greek merchant only rarely opens direct negotiations with oversea producers, and foreign exporters have more often to treat with commission agents whose standing in consequence becomes of first importance. To obtain all needful details regarding such firms' credit and reputation, French exporters have only to apply by letter to the French Chamber of Commerce at Athens-Piræus, or, in Paris, to the Office National du Commerce Extérieur (which bodies would, doubtless, extend their services to British exporters, in special cases). Additionally, the French Consul also advises a more extensive employment of travellers, if only to counterbalance the local activities of the numberless German travellers in Greece. Particular attention must likewise be given to the drafting of the terms of the agreements come to. The bills of lading drawn in duplicate and sent by two different routes, should be as much as possible made out in a way to lessen the risks of the misappropriation of this deed and the diversion of the goods to improper third parties. Packing should be light, but strong. Settlement is made through a bank, which hands the documents to the purchaser against payment forthwith or against an accepted bill. The French exporter is dissuaded from drawing directly on the purchaser. Credit varies from two to three and from six to 12 months, and as the renewal of bills is common throughout the Levant, exporters would commit a great error in showing themselves too strict on this head. In Greece commercial causes come before the civil courts; suits are decided by a Commission of Customs officials, which is attached to the Ministry of Finance, against whose decisions there is no appeal. The French Consul advises the making out and forwarding of invoices in the fullest detail, with gross and net weights of each article; to pack goods in solid cases, banded if possible; to insure against theft and other risks, and to indicate on the invoice the name of the representative in Greece of their insurance company to whom the goods-receiver should prefer his claim for damage or loss. It is to be observed that all commercial travellers are subject to special regulations, prescribed by Article 6 of the Commercial Code arranged between Germany and Greece, whereby among other things, they must be furnished with a letter of recommendation subscribed by a competent authority in their own country; samples which they bear are allowed duty free only on condition that they are re-exported unmutilated within from six to 12 months, and subject to fulfilling certain Customs formalities. Commercial travellers are likewise exempt from the patent tax, if Greek commercial travellers are granted a like exemption. The office of the French Chamber of Commerce in Greece is available for use by French commercial travellers for the reception of their correspondence, and, on occasion, for the exhibitions of samples.—*La Revue Electrique.*

The Board of Trade C.I.B.—At a recent meeting of the Advisory Committee of the Board of Trade Commercial Intelligence Branch, it was reported that the number of written and personal inquiries received, exclusive of the foreign samples section, during 1915 was 50,400, as compared with 40,600 in 1914, and that in view of the success which had attended the British Industries Fair, the Board of Trade had decided to hold a similar Fair next year, to be opened on February 1st.—*Daily Telegraph.*

Aircraft Constructors.—The *Times* records the formation of the Society of British Aircraft Constructors, Ltd., to encourage, promote, and protect British aircraft industry. Among the firms who have signified their intention to join are:—Austin Motor Co. (1914), Ltd., Wm. Beardmore & Co., Ltd., Boulton and Paul, Ltd., Brush Electrical Engineering Co., Ltd., Mann, Egerton and Co., Ltd., Handley & Page, Ltd., Phœnix Dynamo Manufacturing Co., Ltd., Robey & Co., Ltd., Ruston, Proctor & Co., Ltd., Vickers, Ltd., and G. & J. Weir, Ltd.

Liquidations.—Ilkeston Motor and Electrical Engineering Co., Ltd.—Creditors must send particulars of debts, &c., to the liquidator, Mr. A. Boaler, King Street, Nottingham, by May 16th.

Teleradio Electric Co., Ltd.—A meeting is to be held on May 22nd, at Balfour House, E.C., to hear an account of the winding up from the liquidator, Mr. E. H. R. Trenow.

Ardwick Electric Regulator Co., Ltd.—This company is winding up voluntarily with Mr. J. W. Shepherd, 78, King Street, Manchester, as liquidator. A meeting of creditors is called for May 5th.

British Accumulator Co., Ltd.—Meeting of creditors, May 4th, at Tanfield Buildings, Bradford.

Trade Announcements.—In order to expedite delivery of telegrams to the Edison & Swan United Electric Light Co., Ltd., Ponder's End, Middlesex, customers are asked to address all telegrams: "Ediswan, Enfield," when communicating with the Ediswan Works.

The new works of Messrs. Austin Walters & Son are at Gaythorn Electric Works, Manchester. Their old address was inadvertently given in our paragraph of last week. The word *stores* in the last line but one of that paragraph, of course, should have read *stoves.*

The Greenly Advertising Service have issued a folder entitled "Preparedness," briefly explaining the service which they are prepared to render. Copies will be sent to manufacturers and merchants on receipts of an inquiry to 37 and 38, Strand, W.C.

The General Insulate Co., 1008-20, Atlantic Avenue, Brooklyn, N.Y., makers of "Insulate" and "Hi-Heet" moulding compound, are extending their works so as to more than double their present capacity.

Book Notices.—*The Relation of Imports to Exports.* By J. Taylor Peddie. Second Edition. London: Longmans, Green & Co. 5s. net.—The author describes this book as a study of the basis of a new National and Imperial Policy. A series of essays, in which a number of leading authorities are quoted at length, has been written to induce the public to see that all questions relating to the welfare of the State should be judged from the national point of view, and not from the standpoint of political party or individual interest. In the introductory notes the author holds that the destiny of nations is now guided by the efficiency of their systems of national economics. He takes credit that another volume of his was "largely instrumental in bringing about the formation of a strong Industrial Research Committee, under the auspices of the Government," which has placed £30,000 at its disposal. We are inclined to think that some others also believe that they were "largely instrumental" in that connection. In the preface to the second edition, he asserts that a great many of the legislative measures approved of in recent years would have taken on a much different character if they had been based on a clearly defined national policy, and this volume is submitted with a view to making a beginning in this direction. The essays in which he unfolds the national policy are "The Relation of Imports to Exports; Foreign Exchange (the Bill of Exchange)"; "National Economics or Empiricism?" Part of the last of these, as he says, was read after luncheon to the Institute of Industry in January last. The four immediate objects which he considers the public should aim at establishing before the war concludes, or shortly thereafter, are Nos. 1, 2, 3 and 6, which were published in the Electrical Review for January 21st, page 66—a Ministry of Industry, better representation in Parliament of national industry, finance, science and commerce, the establishment of industrial banks, and the standardisation of our educational system.

"Scientific Papers of the Bureau of Standards": No. 260, Centre of Gravity and Effective Wave Length of Transmission of Pyrometer Colour Screens, and the Extrapolation of the High Temperature Scale; No. 261, Studies of Instruments for Measuring Radiant Energy in Absolute Value: an Absolute Thermopile; No. 264, Photometry of the Gas-filled Lamp; No. 265, Life Testing of Incandescent Lamps at the Bureau of Standards; No. 269, Effect of Imperfect Dielectrics in the Field of a Radio-Telegraphic Antenna. "Technological Papers of the Bureau of Standards": No. 62, Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways; No. 63, Leakage of Currents from Electric Railways; No. 68, Standardisation of Automobile Tire Fabric Testing.

"Circular of the Bureau of Standards": No. 14, Analysed Irons and Steel Methods of Analysis; No. 17, Magnetic Testing.

"*Journal* of the Röntgen Society." No. 47. Vol. XII. April, 1916. London: Percy Lund, Humphries & Co., Ltd. Price 4s. net.

Bankruptcy Proceedings.—A. F. Hawdon, electrical engineer, Gosforth.—Application for discharge is to be heard at Newcastle-on-Tyne, on May 11th.

J. Swainson, electrical contractor, Chorlton-cum-Hardy and Manchester.—Trustee (Mr. A. Yearsley) released March 24th.

Catalogue.—British Thomson-Houston Co., Ltd., Rugby.—List No. 4,501 C, giving an illustrated description of, and price and dimensional information respecting, lightning arresters for C.C. circuits.

LIGHTING AND POWER NOTES.

Argentina.—A preliminary meeting of shareholders of the newly constituted co-operative association for the supply of electric light and energy in Mar del Plata has been held. The installation is expected to be working by next summer season. It is proposed to charge 40 cents per unit during the summer and 25 cents during the winter months.

After careful consideration of the request of the Compania Alemana Transatlantica de Electricidad for permission to supply electric current by means of aerial wires in certain of the less densely-populated districts of the Federal Capital, the request has been granted, similar permission, however, being accorded to all other electrical companies operating in the city.

Australia.—The *Commonwealth Engineer* recently summarised the position of the controversy regarding the departure from standard frequency and voltage in the case of the West Australian Government's power plant at Perth. The Federal Council of the Electrical Association of Australia has endeavoured to induce the W.A. Premier to conform to the existing standards, pointing out the disadvantages which will arise from the Perth

area having to be specially provided for, in view of the 40-cycle A.C. supply and 250-volt consumers' pressure which is being adopted, but has apparently been unsuccessful. It may be added that 50 cycles has been generally adopted for A.C. work on large Australian supply undertakings, while the voltage adopted for Perth consumers, 250 volts, adds to existing divergencies as follows:—Adelaide 200, Brisbane 220, Melbourne 200 and 230, and Sydney 240 volts.

Aylesbury.—Loan Application.—The U.D.C. has applied to the L.G.B. for sanction to a loan of £550 for battery extensions at the electricity works. The Council has agreed that notice be given to the occupier of the Bull's Head Hotel to discontinue receiving current from the Aylesbury Electric Theatre, Ltd., or any company or person other than the Council.

Burton-on-Trent.—The T.C. has decided to carry on the cable extensions to cost about £600, including the provision of transformers and motors, and to meet the cost out of revenue. The extensions are needed for additional power customers.

Cardiff. — Restricted Lighting. — The electrical engineer reported to the Tramways and E.L. Committee that the new lighting restrictions order, which came into force on the 14th inst., would mean a loss of £20,000 to the department. There have been no restrictions in lighting up to now.

Grimsby.—The Electric Lighting Committee has decided not to accept any new consumers of current for lighting purposes, the plant being already overloaded. The engineer, in his report, recommends that a scheme of extensions be prepared, so that orders can be placed immediately on the close of the war. The report was adopted. The Committee agreed, in the event of the war being over by next winter, to continue the existing restrictions as to private and public lighting.

Heywood.—Although the actual figures showing the result of the working of the electricity department during the past year have not yet been made public, the Electricity and Tramways Committee has decided to ask for a sum equal to the production of a 4d. rate for the reduction of the adverse balance; last year a 5d. rate was granted.

India.—Electric Power Schemes.—In view of the growing demand for electric power in Mysore, Mr. S. G. Forbes, chief electrical engineer, has formulated two projects to supplement the present works at the Cauvery Falls. They are known as the Shimsha and the Kededatu schemes, estimated to cost 67 lakhs and 30 lakhs respectively. Power from these would be fed into the existing transmission cables. Increased production up to 40,000 H.P. is provided for, with a further possible increase up to 50,000. In discussing a paper on the subject before the Mysore Engineers' Conference, Mr. Forbes, besides forecasting a possible supply of 3,000 to 4,000 H.P. for Madras City, points out that the railway from Bangalore to Mysore can be electrified. He thinks the schedule of trains over this 87 miles' section could be so arranged that power consumption would be fairly uniform throughout the day at an average of 1,000 H.P.—*Indian Engineering.*

Itchen.—Prov. Order.—The B. of T. has informed the U.D.C. that it has no power to grant an extension of the E.L. order for three years after the war as requested by the Council, but under the existing circumstances it will defer the question of revoking the order for a year.

London.—St. Pancras.—The Ministry of Munitions has agreed to the request of the B.C. that the contracts in connection with the King's Road station extension may be declared war contracts, so far as the two new boilers and the building portion of the work are concerned. The Ministry suggests, however, that the installation of the coal storage bunkers and coal and ash-handling plant should be left over, if possible, in order to economise in the use of steel. The Electricity Committee thinks it important that the whole of the portion of the station extension scheme now arranged for should be allowed to proceed without modification, and it has accordingly appointed a deputation to wait upon the Ministry to explain the urgent needs of the case.

Woolwich.—A supply of current is to be given to a large firm engaged on Government work, necessitating the purchase of apparatus, and at a total cost of £140. Having regard to the fact that the amount of coal to be handled at the Globe Lane Station has nearly quadrupled, and there is every possibility that it will further increase, the Electricity Committee's original proposal to purchase a grab to be fitted to the existing telpher is quite insufficient to meet present needs, and it is reported that other arrangements have been made in connection with the existing extensions now being completed. The B.C. has received sanction to the borrowing of £3,290 for mains, transformers and hire rentals.

Luton.—New Plant.—The electrical engineer reports that two new boilers, an economiser and steel piping, and ash and soot-handling plant, will be required for next winter's load.

Lymington.—Price Increase.—The Electricity Co. has informed the T.C. that as from March its charges for current will be further increased by 5 per cent.

Manchester.—Rate Aid.—At the meeting of the Electricity Committee to consider the estimates, it was stated that in order to provide the £30,000 for rate aid for the previous year £1,825 had to be taken from the reserve fund, the surplus available being £28,175, as against £34,426 the previous year. The number of units sold for the year ended March 31st, 1916, was 141½ millions, as against 127¾ millions for 1915, and the income had risen from £530,740 to £605,652. For the current year the Committee estimates that the sales will increase by about 42 million units. Owing to the high price of fuel and other costs the estimated surplus on the year's working is £9,000. To provide the £30,000 for rate aid it will be necessary to withdraw the balance in the reserve fund and carry forward as a debit against the year 1917-18, £10,943.

Mexborough. — Proposed Loan.—The U.D.C. has decided to apply to the L.G.B. for sanction to borrow £700 for the purchase of a new boiler, &c.

Rathkeale (Co. Limerick).—Workhouse Lighting.—The average cost of gas lighting for the workhouse for the six years 1909-14 was £100 per annum, while the electric light bill for the year ended in March, 1916, showed a cost of only £65.

Rochdale.—Year's Working.—The working of the electricity department during the past year shows a profit of £2,537, compared with £1,522 in the previous year, and a loss two years ago of £330. The income amounted to £51,307, compared with £33,553, an increase of £17,754. Working expenses amounted to £30,379, compared with £18,279, an increase of £12,100. The gross profit was £20,928, or £5,655 more than in the previous year. Interest and sinking fund charges, and allowances to employés on active service, amounted to £18,390, compared with £13,751 in the previous year. The depreciation fund amounts to £10,286, the sinking fund to about £35,000, and there is £4,857 in the reserve fund. The capital value of the undertaking is given as £227,673. Last year £1,500 was contributed to rate relief, but this year it is recommended that the profit of £2,537 shall be placed to reserve.

It is proposed to apply for L.G.B. sanction to the borrowing of about £60,000 for extensions to the electricity works building and plant, in accordance with recommendations in the report of Mr. S. L. Pearce, Manchester city electrical engineer, who has recently been called in to prepare an expert report.

Southampton.—In the course of a report upon the condition of the machinery and mains, the electrical engineer reminds his Committee that last year English agents found it difficult, and finally impossible, to obtain brushes from Germany for the Willans turbo-generator. For some months this machine was run as little as possible, in order to eke out the stock, there being no English makers of these brushes. Sample brushes obtained from a French firm have now proved fairly satisfactory.

Stratford-on-Avon.—Price Increase.—The T.C. has consented to the Electricity Co. increasing the charge for energy for lighting from 5d. to 6d. per unit for the year or for the duration of the war.

Tasmania.—Owing to delay in the delivery of material, the Government's Great Lake hydro-electric scheme is not likely to be ready to supply light and power before May. The turbines at the power station were given a trial run recently, when the machinery ran smoothly, and everything was in good order. All that remains to be done before power is available at Hobart is to carry the transmission line across the Derwent at Bridgewater.

Tynemouth.—Year's Working.—The report of Mr. Turnbull, the borough electrical engineer, on the working of the electricity department for the year ended March 31st last, shows that the total units sold amounted to 4,809,841, as against 4,296,305 in 1914-15; of these, 2,844,860 were three-phase units supplied to large consumers not over the Council's mains, while of the balance 1,833,893 units were purchased in bulk, and only 291,653 units were generated by the Council's plant. The total revenue for the year was £23,030, and the net surplus, after meeting all expenses, £738, as compared with £1,787 in the previous year.

Watford.—Loan Sanction.—The U.D.C. has received sanction to the borrowing of £1,625 for electricity purposes.

West Ham.—The electrical engineer reports having obtained quotations for further automatic protective devices to be used in connection with the three main generators, and that he proposes to put these on order immediately. When installed, these devices, the engineer submits, will bring the principal generators into line with the most modern practice in regard to automatic protection.

Weymouth.—Price Increase.—The T.C. has decided, in view of the loss of £1,500 on last year's working, that the charges for electricity be increased as from April 1st as follows:—15 per cent. on lighting and fixed price lighting, 20 per cent. on heating, cooking, power and contract supplies, and that the meter charges be reduced from 2s. 6d. to 1s. per quarter.

Wolverhampton.—Price Increase.—The T.C. has decided to advance the price of electricity by 10 per cent.

Application is being made to the L.G.B. for sanction to borrow £17,100 for the extension of the Corporation's electricity plant.

TRAMWAY and RAILWAY NOTES.

Australia.—The Minister of Victorian Railways (Mr. H. McKenzie), states that satisfactory progress has been made towards the inauguration of the surburban electrification scheme. Contingent upon the arrival of sufficient apparatus from the contractors, Messrs. Siemens Bros. Dynamo Works, Ltd., it would be practicable to commence the running of electric trains on the line between Essendon and Sandringhan about the end of the year. The Agent-General and the consulting engineer, Mr. Merz, had waited on the Minister for Munitions to obtain his consent to the contractors proceeding with their work, but they were unable to obtain any definite promise. The Commissioners are in communication with Mr. Merz who has requested the contractors to submit any proposal they can make for the early completion of the contracts. The Minister stated that the present indications are that the determining factor in the matter will be the supply of switchgear.—*Melbourne Age.*

Birmingham.—Trailer Cars, &c.—The Tramways Committee reports that no definite decision has been arrived at with reference to the running of trailer cars. A car was being prepared, and would be placed on the Handsworth route as an experiment; if successful, the question of introducing such cars upon the tramway routes of the city would be considered.

The scheme for constructing a branch tramway off the Erdington route, to open up communication with Tyburn, had been postponed until after the war; meanwhile motor-'buses, of which several of the 12 ordered had been delivered, would be used to convey employés to the works in that district.—*Birmingham Daily Post.*

Blackburn.—Year's Working.—The annual report of the Corporation tramway department for the year ended March 31st last, shows that the total revenue was £68,410; the working expenditure amounted to £46,964, and after meeting financial charges the net balance was £1,757 as against £1,572 in 1914-15. The figures mentioned scarcely vary from those of the previous year. An increase of about £1,200 in war grants has been met by savings in other directions. Less miles have been worked and more passengers carried, the totals for the year being 1,091,050 car miles and 12,246,151 passengers. The receipts per c.m. reached 14·17d.

Blackpool.—Year's Working.—The gross profit on the Corporation tramways for the last 12 months was £35,036, the total income being £80,070. After allowing for interest, sinking fund repayments, &c., there was £16,275 available for the relief of the rates, reserve funds, &c. The year was financially the third best in the history of the tramway undertaking, there being a disposable balance of £24,552 in 1913-14, and of £17,664 in 1912-13.

Bradford.—Railless Goods Traffic.—Owing to the shortage of team labour and cartage facilities the question of utilising the tramway system for the conveyance of goods has been considered by Mr. C. J. Spencer, the tramways manager, with the result that a vehicle has been built by the tramway department as an experiment to run on the railless trolley principle, fitted with accumulators which will take in a supply of current from the overhead wires. It is considered that such a vehicle might be loaded with merchandise at a railway goods depôt and follow the tramway system to almost any part of the city. It is calculated that one of these vehicles would do the work of 10 men and 10 horses and carts, and at considerably less cost. The matter has been placed before the B. of T. by Sir Wm. Priestley, M.P., and Ald. James Hill, M.P., and the authorities in London have granted every possible facility. It is proposed to erect a number of vehicles of the type in question, and the experiment at Bradford will, it is understood, be watched by the B. of T., with a view to its development in other centres.—*Leeds Mercury.*

The general manager (Mr. C. J. Spencer) presented a report to the Tramways Committee regarding the issue of free tramway tickets during the year ended March 31st last. During the 12 months 442,230 free tickets were issued to soldiers, Belgians, and visitors attached to the Lord Mayor's Relief Fund, the aggregate value of these being £2,770. The proportions were: 333 400 to soldiers (£2,084), 97,180 to Belgians (£607), and 12,650 to Lord Mayor's Relief Fund visitors (£79).

Bury.—Year's Working.—The profit on the Bury sections of the Corporation tramways during the past year was £7,314, and it was decided to recommend that this should be apportioned as follows: insurance fund account, £1,000; reserve and depreciation fund, £1,314; and borough rates, £5,000. On the Radcliffe section a profit of £769 was made under the first agreement, and a loss of £368 under the second agreement; this is borne partly by Bury and partly by Radcliffe.

Croydon.—Strike.—At a meeting, on Tuesday, the employés of the South Metropolitan Tramway Co. decided to return to work at once, subject to certain guarantees; the Corporation employés, who also took a vote on the position, decided to remain out until the T.C. agrees to arbitrate or to have a meeting of both sides, with an independent chairman.

Darlington.—The Electricity and Light Railways Committee's report of the tramway revenue last year showed an increase of nearly £1,000. An increased demand for electricity was reported, by about 40 per cent. as compared with the previous year.

Female Tramway Drivers.—The Tramway and Vehicle Workers' Association has made representations to the B. of T. and the Ministry of Munitions against the suggested employment of women as tramway drivers, and the secretary of the Union, Ald. Jackson, of Salford, stated last week that requests had been made that the departments named should receive deputations on the subject. The Union contends that no case has been made out for the employment of women as car drivers, or for the assumption that men over military age cannot be obtained for the work.

Hyde.—Female Labour.—At the local Trades Council on the 18th inst. a protest was made against the proposed introduction of women as tramway drivers in the district. It was stated that the local Joint Tramways Board had invited applications from males or females who wished to learn driving.

Heywood.—Year's Working.—During the past year the loss on the tramway undertaking amounted to £518, compared with a loss in the preceding year of £1,042. The gross income amounted to £11,985, an increase of £358, and the gross expenditure to £12,503, a decrease of £165. It has been decided to ask the Corporation for a sum equal to the production of a penny rate for the reduction of the adverse balance.

Kingsbury.—The District Council is giving support to the application of the M.E.T. Co. for permission to use trailer cars

Leeds.—Year's Working.—The returns of the Tramway Department for the year ending March 31st 1916, show that the income was £475,505 (traffic receipts £467,197; haulage of minerals £2,620; and rents £5,054) representing an increase of £40,994 as compared with a year ago. The working expenses were £230,715, as against £228,134 in the previous year, which left a gross profit of £239 278 as compared with the previous year's £206,376. To this is added £10,302 in respect of bank interest and dividends, and redemption fund investments bring the net revenue to £249,589, £35,375 in advance of the previous year. From this has to be deducted interest on capital £49,474; income-tax £15,319; rent of lines £3,072; allowances to dependents of employés serving with the Colours £13,271; redemption fund contribution £64,789; permanent-way renewals and exhausted loan on power plant sold during the year £11,550; reserve fund for third party risks £2,044, leaving a net surplus of £86,822, representing an increase of £5,255 as compared with the figure for a year ago. Of this surplus £15,000 is placed to the reserve fund, and £71,822 is to be devoted to the relief of the rates.

L. & Y. Electrification.—A tabular statement which has been prepared in connection with the electric train service between Manchester and Bury (which was inaugurated last week) shows that the electric system cuts down the time of the journey substantially. By steam train the journey from Manchester to Bury, with stops, is shown as taking 32 minutes, as compared with 24 minutes on the electric service. From Bury to Manchester the time by steam train is 29 minutes, and 22 minutes by electric train.

Manchester.—Estimates for 1916-17.—The Tramways Committee, after considering the annual estimates of receipts and expenditure for the year 1916-17, has agreed to contribute £100,000 to the relief of rates as it has done on two previous occasions, but to do this it is probable £10.865 will have to be taken from the reserve and renewals fund. This rate contribution was fixed by the City Council three years ago, and it is considered that it will have to be revised before the end of the year. For war service allowances the department paid £31,764 for the year ended March, 1915, last year the amount was £92,881, and for the current year it is estimated that £94,000 will be necessary, making a total in three years of £218,645. Last year's revenue was £939,416, an increase of £27,540 over the previous year and £14,106 higher than 1914 which was a record year; the car miles run were 18,486,440, and the passengers carried, 209,853,344, an increase of 7,084 924 over 1915. The revenue per car mile was 12·196d. as against 11·3d. in 1915. The estimated expenditure for 1916-17 is £930,365 based on an estimated car mileage of 18,500,000. After providing for the payment of £100,000 to the city fund and meeting the extraordinary expenditure arising out of the war, viz., war services allowances, £94,000 and £40,000 income-tax, the department will not only be unable to make any provision for renewals, but it is estimated that there will be a deficiency of £10,865.

Northampton.—Precautions which have been taken in case of Zeppelin raids, almost led to a strike of the Corporation tramway employés last week-end. The tramcars ceased to run a fortnight ago at 8 p.m. and this led to a reduction of the working hours and a consequent loss of wages to the drivers and conductors of the cars of from 7*s.* to 8*s.* per week. An offer by the Tramway Committee to pay half rates for the lost time was declined. After further consideration the Committee agreed to the demands.

Portrush and Giant's Causeway.—County Court Judge Orr, sitting at Ballymoney, Co. Antrim, decided that the Portrush and Giant's Causeway Electric Tramway was to be assessed as a tramway, not as a railway, and that the Portrush Urban Council was therefore entitled to recover £8 in its action against the tramway company for moieties of poor-rate and consolidated town rate.

Rochdale.—Year's Working.—The net profit of the Corporation tramways for the year just ended amounts to £3,608, a decrease of £676 by comparison with that of the previous year, and it has been decided to ask the Council to approve the placing of the whole of the profit to the renewals fund, which will then stand at £22,149. The gross takings to March 31st last amounted to £87,908, an increase of £4,733. Working expenses amounted to £48,121, an increase of £1,283. Interest on loans, income-tax, sinking fund, rent of leased lines, and receipts due to Heywood, accounted for £34,780, as against £32,652 in the previous year; half wages to men on active service, and war bonus to employés remaining with the department, amounted to £3,262, as against £1,208 a year ago. The sinking fund has been increased from £108,033 a year ago to £120,868 at present.

Southampton.—Electric Vehicle.—The Tramways Committee has decided to purchase an Edison battery automatic tip-wagon at a cost of £950, and to pay for the same out of the depreciation and renewals fund.

Southend-on-Sea.—According to a financial statement prepared by the borough accountant, the total loss incurred on the motor-'bus undertaking, subject to loss on realisation of the assets still in hand, amounts approximately to £1,179. Edison Accumulators, Ltd., has offered to supply additional 'bus chassis at the price tendered in April, 1915—viz., £890 each—and also to replace the existing motor-'bus chassis with a new model, less a sum in respect of depreciation. The Committee has adjourned consideration of the matter until after the war. The Committee has resolved to try, as a tentative measure, the services of suitable women and girls with a view to utilising them as temporary drivers.

Stalybridge.—In connection with the protest of the Trades Council against the contemplated employment of women as tramcar drivers, it was reported at a meeting of the Council last week that the commercial manager of the Joint Tramways Board had written stating that women drivers would only be put on in the last resort, and then only after thorough training and on level routes. No driver was allowed on hilly routes until after two years' service. It was decided to leave the matter where it was for the present.

West Ham.—The B. of T. has given its consent to the Corporation's proposal to substitute a double line of tramway track for the existing interlacing lines in Woodgrange Road. The Tramways Department proposes to purchase a second-hand motor-lorry for cartage purposes.

York.—Female Labour.—The Tramways Committee proposes to instruct women as drivers of the Corporation cars, and the tramway manager has asked the drivers and conductors if they would be willing to work with women drivers, and would be prepared to stand by the Corporation in the event of disturbance with other employés. The matter has been referred by the men to the Tramways Trade Union, which has requested the Committee to receive a deputation before taking any action in the matter.

It was proposed at a meeting of the Tramways Committee that four women should forthwith be instructed as drivers; an amendment that no action should be taken until the Committee had received the deputation from the Union was carried on the casting vote of the chairman.—*Manchester Guardian.*

TELEGRAPH and TELEPHONE NOTES.

Constantinople.—A letter addressed to a German newspaper in March contains a reference to the situation of the telephone service in the Turkish capital. A few days previously the Turks celebrated the anniversary of the taking-over by the Government of the undertaking of the English Telephone Co. According to the well-known newspaper the *Tanin*, the sequestration of the undertaking was due, apart from the state of war with Great Britain, "to the defective fulfilment of the obligations and the conditions of the concession assumed by the English company." On the occasion of the celebration the present general manager of the telephone system sought to prove that the Turkish administration had turned out far superior to the former English management, and that the statement of the retiring Englishmen, who predicted that the telephone service would be suspended within two months, had come to nought. It was mentioned in this connection that, notwithstanding the scarcity of materials, the number of exchanges had increased during the year, simultaneously with a reduction in the number of telephone girls from 120 (!) to 94, some of whom are young Turkish girls. At the same time the daily conversations had risen from an average of 8,600 to 23,000. These figures were also quoted by the Turkish newspaper in question, which added that no single employé was now in the service who was not an Ottoman subject.

Glasgow.—The opposition of a number of subscribers to the increase in telephone rates for unlimited service has resulted in the formation in Glasgow of a Telephone Subscribers' Defence Association.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—May 24th. N.S.W. Government Railways and Tramways. 16 600-volt D.C. motors for tramway stores, Randwick.*

Melbourne.—May 1st. City Council. Meters and maximum-demand indicators. See "Official Notices" April 7th.

May 31st. Victorian Government Railways. Transformers for five years. First order, 220 transformers in six months.*

Birkenhead.—May 2nd. Electricity Department. Twelve months' supply rough slack, small coal and coke breeze. Electrical Engineer, Craven Street.

Glasgow.—May 4th. Electricity Department. Twelve months' supply of cables and meters. See "Official Notices" to-day.

New Zealand.—June 23rd. Oamaru Borough Council. Overhead mains and street-lighting equipment (Contract No. 2); power-station equipment (Pelton wheels, alternators, &c.) (Contract No. 3); service meters (Contract No. 4); line transformers and accessories (Contract No. 5).*

Salford.—May 8th. Electricity Department. High-pressure steel steam pipes and separator, also cast-iron pipes and valves. See "Official Notices" April 21st.

West Hartlepool.—April 28th. Electricity Department. Two water-tube boilers with superheaters and mechanical stokers. See "Official Notices" April 14th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Bray.—U.D.C. One year's supply of electricity meters: Electrical Apparatus Co., Ltd.

Burton-on-Trent.—T.C. Coal (4,000 tons) for the electricity works: Messrs. Jonathan Longbottom & Sons.

East Ham.—Accepted tenders for coal for the Electricity Department for 12 months:—

E. & A. Shadrack.—1,000 tons Nailstone best hand-picked hards, £1 4s. per ton; 2,000 tons Nailstone best 1½-in. nutty slack, £1 1s. 10d.; 1,000 tons Swadlincote 1½-in. nutty slack, £1 2s. 11d.; 2,000 tons Cadley Hill 1½-in. best nutty slack, £1 2s. 5d.

E. Foster & Co.—1,500 tons Bestwood washed peas, £1 1s. 8d. per ton; 1,000 tons Craigola Welsh large steam, £1 8s. 11d.; 1,500 tons Pooley ¾-in. slack, 19s. 5d.; 1,000 tons Ibstock slack, 16s. 5d.

Government Contracts.—List of new contracts for March, 1916:—

War Office.

Secondary batteries.—Premier Accumulator Co., Ltd.; Pritchett & Gold and Electrical Power Storage Co.

Electric cable and wire.—B.I. & Helsby Cables, Ltd.; Callender's Cable and Construction Co., Ltd.; Connolly Bros., Ltd.; Hooper's Telegraph and India-rubber Works, Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; St. Helens Cable & Rubber Co., Ltd.; Saxonia Electrical Wire Co., Ltd.; Siemens Bros. & Co., Ltd.; Yorkshire Cable Co., Ltd.

Electric cells.—J. C. Fuller & Son, Ltd.; Siemens Bros. & Co., Ltd.

Electric lighting sets.—Day Motor Co., Ltd.

Generating sets.—Aster Engineering Co.; Austin Motor Co.; W. H. Dorman & Co.; Electric and Ordnance Accessories Co.; Fyfe, Wilson and Co.; Keighley Gas & Oil Engine Co.; Arthur Lyon & Wrench, Ltd.; New Pelephone Engine Co., Ltd.; Norris, Henty & Gardners, Ltd.; Parsons Motor Co., Ltd.

Electric lamps.—Brimsdown Lamp Works, Ltd.; Bulpitt & Sons, Ltd.; Dick, Kerr & Co., Ltd.; Edison & Swan U.E.L. Co., Ltd.; E. Griffiths and Sons; Lyon & Wrench, Ltd.; Siemens Bros. Dynamo Works, Ltd.

Switchboards.—Park Royal Engineering Co.; Siemens Bros. & Co., Ltd.

Transformers.—British Electric Transformer Co., Ltd.

Works services.—Electric light, &c., Crayford: Pinching & Walton. Electric light at Clipstone Camp, Mansfield: V. G. Middleton. Electric light at Park Hall, Oswestry: V. G. Middleton. Power house and equipment at Wigton: Girdleston & Co.

India Office Store Department.

Generator sets.—Lancashire Dynamo & Motor Co.; Dorman, Long & Co.

H.M. Office of Works.

Engineering works.—Electric passenger lift, Edinburgh Inland Revenue Office: Aldous & Campbell, Ltd. Westminster Government Offices, Southern Buildings Extension: Electric paper and coal lifts, Medways Safety Lift Co.; electric passenger lifts, Waygood-Otis, Ltd.

Post Office.

Telegraph apparatus.—Creed, Bille & Co., Ltd.

Telephone apparatus.—B.I. & Helsby Cables, Ltd.; Siemens Bros. & Co., Ltd.

Testing apparatus.—General Electric Co., Ltd.

Tubular iron telegraph arms.—Bullers, Ltd.

Telephone cable.—Telegraph Construction & Maintenance Co., Ltd.

Bronze wire.—T. Bolton & Sons, Ltd.; Shropshire Iron Co., Ltd.; F. Smith and Co., Ltd. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).

Copper wire.—T. Bolton & Sons, Ltd.; B.I. & Helsby Cables, Ltd.; Elliott's Metal Co., Ltd.; Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); Wilkes, Son & Mapplebeck, Ltd.

Commissioners of Public Works, Ireland.

New Public Offices, Dublin, South Block: electric wiring, bells, switchboard, &c.—V. G. Middleton.

High Wycombe.—T.C. Refuse destructor: Messrs. Goodrich & Hamlyn, £1,435.

Llandaff and Dinas Powis.—Rural District Council. One year's supply of A C. meters: Electrical Apparatus Co., Ltd.

Leyton.—The quotation of Messrs. Edgar Allen & Co. has been accepted, at £480, for a new lay-out.

Mexborough.—U.D.C. Water-tube boiler, £615: Messrs. Babcock & Wilcox, Ltd.

Southampton.—The Electricity Committee, having received tenders for British-made meters, has decided to divide the contract between Messrs. Chamberlain & Hookham and Messrs. Ferranti, Ltd., and has authorised the engineer to obtain any additional meters from the British Thomson-Houston Co. at prices not exceeding those quoted by the other firms named.

The Tramways Committee proposes to accept the tender of Mr. G. P. Wilson for brake blocks and castings, at £5 12s. 6d. per ton, an increase of 8s. per ton compared with last year.

Southend-on-Sea.—Owing to the increase in the price of materials, the E.L. Committee has agreed to pay the contractors for the supply of joint-boxes an extra sum of 2½d. per box in respect of 250 boxes recently ordered by the electrical engineer. The Town Clerk reports that subsequent to the decision of the Council in January last, to pay £168 to Messrs. Callender's Cable and Construction Co., Ltd., for cable ordered in December, 1914, in connection with the proposed supply of current in the Leigh area (the payment for which had been delayed in consequence of the withholding by the L.G.B. of the sanction to the raising of the necessary money for the purchase thereof, and for the construction of the Leigh sub-station) a portion of the cable had been supplied to the Government, and that Messrs. Callender's had offered either to replace such cable now, undertake to replace it at the termination of the war at the original contract price, or credit the Corporation with the value (£480), plus £210, being the increased value of the copper at the existing market price, thus reducing the amount payable to the firm to £991. The Committee has decided to accept the last-named offer.

Corporation. B.I. & Helsby Cables, Ltd.: Six miles of overhead trolley cable, at 1s. 4¾d. per lb.

West Ham.—The Council's contract with the Fuller Electrical and Manufacturing Co., Ltd., for the supply of motors for the Sales Department terminated at the end of March last. The engineer invited nine leading firms to send in quotations, but only four replied. Out of these that of the Fuller Co. was the only complete one; their prices, although much higher than last year, were slightly lower than those of any of the other three on most of the items, and slightly higher on two or three other items. The firm intimated, however, that they would not enter into a contract and reserved the right to increase prices at a month's notice. Under the circumstances the engineer proposes to continue to buy from the company until such time as it seems desirable to make another contract.

FORTHCOMING EVENTS.

Society of Engineers.—Monday, May 1st. At 5 p.m. At Caxton Hall, S.W. Conference on "Engineering and Scientific Research," to be opened by Dr. J. A. Fleming, M.A., F.R.S.

Institution of Electrical Engineers (Birmingham Local Section).—Wednesday, May 3rd. At 7 p.m. At the University, Edmund Street. Annual meeting.

Chemical Society.—Thursday, May 4th. At 8.30 p.m. At Burlington House, W. Ordinary scientific meeting.

Iron and Steel Institute.—Thursday, May 4th, at 10.30 a.m., and Friday, May 5th, at 10 a.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual general meeting.

Royal Institution of Great Britain.—Friday, May 5th. At 5.30 p.m. At Albemarle Street, W. Lecture on "Electrical Methods in Surgical Advance," by Sir J. M. Davidson.

Saturday, May 6th. At 3 p.m. At Albemarle Street, W. Tyndall Lecture on "X-rays and Crystals: New Methods of Research," by Prof. W. H. Bragg, F.R.S.

NOTES.

Electric Light Switching Examinations.—The results of Messrs. Lundberg's recent examination are given elsewhere in this issue. The continued popularity of these competitions indicates that interest in them is sustained, and we have no doubt that really useful results accrue both to the competitors, who are thus induced to sharpen their wits and study the possibilities of the subject, and to the electrical trade, which will benefit by the increased knowledge thus acquired. A noticeable feature of the list of names is that we find there wiremen, students, Associate Members of the I.E.E., contractors, graduates, and apprentices, showing the width of the field from which the competitors are drawn.

Inquiry.—Makers of small steatite parts are asked for.

The Metric System.—In the paper on "Electric Power in Slate Quarries," of which an abstract appears elsewhere in this issue, there were included drawings which happened to be figured partly in inches as well as millimetres, and these afford interesting examples of the draughtsman's failure to appreciate the meaning of "significant figures." For instance, the original dimension being 310 mm., he gives the English equivalent as 12·2049 in. The latter is an absurdity, for the dimension relates to the frame of a motor, on which an accuracy of one part in 100,000 as here given would be ridiculous. Even to figure to mils is superfluous; the proper equivalent here is 12·2 in. Other instances occurring on the same drawings are the following:—Distance between centres of holes, 440 mm., 17·323 in. (17·32 would suffice); 330 mm., 12·9924 in. (12,99 would suffice). Of course, there should be no occasion for conversion—all the dimensions should be in the same notation, and that metric; but when and whilst conversion is necessary, it ought to be done with the aid of common sense. The dimensions of a bed-plate or motor frame are not gauged to the $\frac{1}{1000}$th of an inch in commercial workshop practice. In most cases $\frac{1}{100}$th in. and $\frac{1}{10}$th mm. are ample limits.

We welcome the decision of the Electric Vehicle Committee, reported on p. 485, to give the metric equivalents of all their standard dimensions (and trust that the error illustrated above will not be allowed to occur).

A report on the use of the metric system in export trade has been prepared by Director S. W. Stratton, of the United States Bureau of Standards. This report was considered so complete and of such a useful character that it has been issued as a Senate document, in the form of a booklet consisting of 80 pages. It will be found interesting by all manufacturers, especially those who are cultivating an export trade.

Institution and Lecture Notes.—Tramways and Light Railways Association.—At the annual Congress of this Association, which will take place on Friday, June 30th, there will be the annual general meeting at Westminster Palace Hotel, at 2.30 p.m., followed by a paper by Mr. W. Tuke Robson, general manager of the Southampton Corporation Tramways, and a discussion thereon. There will be a motor-'bus visit to the L.G.O. Training School, at Milman Street, Chelsea, and after the exhibition of kinema films showing London traffic scenes, with special reference to Rules of the Road for tramcars, 'buses, and other traffic, methods of training, &c., tea will be served during which Mr. Blain will give a short address on "The Safety Movement." The members' dinner will be held in the evening at the Trocadero Restaurant.

Royal Institution.—The lecture arrangements for the coming months include the following:—

Friday, May 5th, at 5.30. Sir J. Mackenzie Davidson, on "Electrical Methods in Surgical Advance."

Friday, May 19th, at 5.30. Col. E. H. Hills, F.R.S., on "The Movements of the Earth's Pole."

Friday, May 26th, at 5.30. Prof. C. A. Barkla, F.R.S., on "X-rays."

Tuesday, May 30th, and June 6th, at 3 o'clock. Dr. T. Martin Lowry, F.R.S., on "Optical Research and Chemical Progress."

Saturdays, May 6th and 13th, at 3 o'clock. (Tyndall Lectures.) Prof. W. H. Bragg, F.R.S., on "X-rays and Crystals." (1) New Methods of Research. (2) First Results and their Applications.

Saturdays, May 20th and 27th, at 3 o'clock. Prof. H. S. Foxwell, on "The Finance of the Great War—New Problems and New Solutions; How we Stand To-day and What Lies Ahead."

The Committee on Neglect of Science.—A meeting will be held at the invitation of this Committee, of which Sir Ray Lankester, K.C.B., F.R.S., is chairman, on Wednesday, May 3rd, in the rooms of the Linnean Society, Burlington House, Piccadilly, London. Lord Rayleigh, O.M., Past President of the Royal Society and Chancellor of the University of Cambridge, will take the chair at 3 p.m.

Resolutions will be submitted stating:—

That it is a matter of urgency, in order to promote national efficiency in the near future, that the natural sciences should be made an integral part of the educational course in all the great schools of this country, and should form part of the entrance examination of the Universities of Oxford and Cambridge, as well as of the newer universities.

That it is in the highest degree desirable that the Government should encourage the study of the natural sciences, and thereby increase the efficiency of our public servants, by assigning capital importance to the natural sciences in the competitive examinations for the Home and Indian Civil Service, and by requiring some knowledge of the natural sciences from all candidates for admission to Sandhurst; and

That the method indicated is the only one by which it is practicable to bring about the desired change in the attitude of the schools and colleges throughout the country towards the natural sciences and to make some knowledge and understanding of those sciences general. As the results of such changes will only develop in the course of years, it is urgent that the matter should be at once taken in hand by His Majesty's Government.

Many well-known public men have expressed their sympathy with the objects of the meeting, and several of them are expected to take part in the proceedings.

Those desiring admission to the meeting should apply to the Hon. Secretary of the Committee on the Neglect of Science, 28, Victoria Street, Westminster, S.W.

Industrial Fatigue.—In our leading article to-day we draw attention to a memorandum issued by the Ministry of Munitions on the subject of "Industrial Fatigue and its Causes" (Memo. No. 7, Cd. 8,213; Wyman & Sons, Ltd. Price 1½d.). The keynote of the report is the necessity for due alternation of work and rest if the maximum efficiency, in the most general sense, is to be attained, the respective durations of these periods depending upon the nature of the occupation. By way of illustration the case is quoted of two officers at the Front, who recently, for a friendly wager, competed in making equal lengths of a certain trench, each with an equal squad of men. One let his men work as they pleased, but as hard as possible. The other divided his men into three sets, to work in rotation, each set digging their hardest for five minutes and then resting for ten, till their spell of labour came again. The latter team won easily. In another instance, a group of five male voluntary Sunday workers in a certain munitions factory were able in eight hours (including one hour for meals), to exceed the average day's output of eight week-day men, who worked 14 hours (including 1½ hours for meals). Whilst the squad probably could not have kept up the pace daily, there could be little doubt that they could repeat their 8 hours' effort on, say, four days a week, and the startling result follows that in those four days they could do more than the whole week's work of an equal set of men working for the longer hours; yet they would have more time for recreation and sleep and three whole holidays in the week. The work was of a uniform "repetitive" kind, involving moderate physical exertion. The experienced manager of a large shell factory employing 1,200 men and 1,500 women states that the system of three 8-hour shifts gives better output and maintains better health than that of two 12-hour shifts, and that there is a period of slacking, *often quite unconscious*, during a 12-hour shift which is detrimental to output.

On the question of Sunday work by exhausted men, a foreman said that he did not believe in "a holiday on double pay." Another foreman said that Sunday work gave "six days' output for seven days' work on eight days' pay." At a large shell-making factory the men during the early months of war worked seven 12-hour day and seven 12-hour night shifts in the week. Recently Sunday work has been stopped, and the men work from 6 a.m. to 7.30 p.m., with 1½ hours for meals, tea being also brought to the men while the machinery is running. The factory now produces an increased number of shells with half the number of workers, and the manager attaches the greatest importance to the week-end rests. At another large munitions factory men engaged in the heavy work of moulding are required by the management to rest 15 minutes in every hour of work, the manager being satisfied that this arrangement was good for the men and for the output. The men objected because they were on piece-work, and they thought the production would be lessened, but the output per hour was found to be actually increased.

References are given in the Memorandum to a report by Prof. Stanley Kent to the Home Office on industrial fatigue (Cd. 8,056, price 4½d.); "Fatigue and Efficiency," by J. Goldmark, New York, 1913; and the Interim Report to the British Association (Manchester, 1915) by the Committee on the Question of Fatigue from the Economic Standpoint. The following works also bear upon the subject: "Motion Study," by Frank B. Gilbreth; London, Constable & Co., Ltd. Price 4s. 6d. net. "Psychology and Industrial Efficiency," by Hugo Münsterberg; London, Constable and Co., Ltd. Price 6s. net.

Electrical Trade in Argentina.—Statistics which are based upon a census are generally of a belated character, and those which were published a few months ago by the Argentine General Administration of Trade and Industry, in regard to an industrial census which was undertaken in Buenos Aires for the year 1913, form no exception. The principle of the census was founded on the Trading-tax Register, and the firms concerned were requested to supply the desired information. It is considered possible that many of the figures returned may have been less than those which were actually the case, on account of the apprehension that the statistics might be utilised for the purposes of taxation. With this reservation a report recently issued shows that there were 45 electricity works in Buenos Aires in 1913, with a share capital of £7,900,000, which disposed of electrical energy for the sum of £2,050,000. The value of the native raw materials consumed by these works was £4,300, whilst that of the imported raw materials amounted to £498,000. The staff employed numbered 735 and the workmen 2,991, the salaries and wages averaging £193 5s. and £135 10s. per annum respectively. The works are for the greater part distributing stations of the German Transmarine Electricity Co., whose former monopolistic position is now threatened by the Italian-financed undertaking of the Cia. Italo-Argentine de Electricidad. It is mentioned that this company has already assured itself of contracts for the supply of energy for the harbour and the Palermo part of the city. Previous to the advent of this rival the price charged for lighting purposes was 5·17d. per KW.-hour, and that for power was 3·06d., but the competition has caused the prices to be reduced. The boilers which supply steam to the turbines in the generating stations are now fired with Mexican oil, and the Transmarine Co. is said to be financially interested in one of the oil-producing companies.

The report, proceeding to discuss the manufacturing side of the question, states that 121 firms produced electrotechnical goods in 1913, the combined capital being £218,000 and the value of the turnover £352,900. In manufacturing these products, inland raw materials of the value of £27,250 were used, whilst the imported materials totalled £68,300. The staff numbered 197 and the workmen 1,168, and the wages averaged £125 and £81 10s. per annum in the two cases respectively. Apart from these undertakings carbon brushes were produced by firms having a capital of £17,500, whose turnover, however, was comparatively insignificant. It is concluded from the figures that electrical work in Buenos Aires is very largely dependent upon other countries, especially as the imports of electrical machinery and plant in 1913 were of the approximate value of £2,000,000.

Appointments Vacant. — Engineer and manager (£400), for the Mexborough and Swinton Tramways Co. See advertisement pages to-day.

Electric Steel.—A South Australian company has in hand a project to establish in each of the capitals of the Commonwealth an electric steel furnace for making cast steel out of scrap iron. The furnace is a Swedish patent, and an English expert will superintend the works.—*Times.*

For Sale.—Greenock Corporation electricity department has for disposal one 500-B.H.P. Belliss & Morcom triple-expansion engine, coupled to a 6-pole Silvertown dynamo, with spare armature. See advertisement pages to-day.

Volunteer Notes.—Engineering Institutions' V.E.C. —Orders for week commencing May 1st, 1916.—By Lieut.-Col. Clay, V.D., Commanding.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Monday, May 1st.—Sections 1 and 2, Technical; Sections 3 and 4, Squad and Platoon, Signalling Class.

Tuesday, May 2nd.—6 to 7 p.m. School of Arms; 7.15 to 8.15 p.m., Recruit Drill.

Thursday, May 4th.—Shooting for Sections 1 and 2, and Signalling Class; Recruits, 5.45 to 7.45 p.m.

Friday, May 5th.—Sections 3 and 4, Technical; 1 and 2, Squad and Platoon.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Volunteer Regiment.—Battalion Orders by Capt. R. J. C. Eastwood (Commandant), Thursday, April 27th, 1916:—

Week-End Parades.—Saturday.—The Battalion will Parade as strong as possible outside Baker Street Station, and proceed by train to Wembley Park for Ceremonial Drill, under the Commandant.

Sunday.—The Battalion will Parade as strong as possible at Liverpool Street Station (low level entrance, G.E.R.), at 9.30 a.m., and proceed by train for Entrenching duties. The Battalion will return to town about 6 p.m. This being the last day on these particular trenches, a large muster is required in order to finish them and leave them in a fit condition to hand over.

Fatigue Party.—A volunteer Fatigue Party is required on Monday, May 1st, at Wembley Park. Members volunteering for this duty should report themselves to the Camp Quartermaster at Wembley Park, at 11 a.m. and 2.30 p.m.

Musketry.—There will be shooting at Bisley on Saturday next, the 29th inst. Names must be sent in to the Musketry Staff, not later than Friday midday. Members proceeding to Bisley must report themselves, in Uniform, to Sergeant Cotter, at 12.45 p.m. No. 6 Platform, Waterloo Station.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Electric Vehicle Committee.—A meeting of the Committee was held in London on April 14th, 1916, Mr. R. A. Chattock presiding. It was announced that all the Associations, with the exception of the Tramways and Light Railways Association, whose reply had not been received, had re-nominated their representatives on the Committee. The Committee re-elected the representatives of the provincial electricity supply companies, makers of electric vehicles, Edison Accumulators, Ltd., and Chelsea Electricity Supply Co., Ltd. It was decided to invite the Motor Manufacturers and Traders' Society to nominate a representative to sit upon the Committee. The present officers of the Committee were re-elected for the present year, except in the case of Mr. A. H. Seabrook, who, by reason of the work he is engaged upon in connection with munitions supply in London, is unable to devote any time to the work connected with the honorary editorship of the *Journal*. This work the hon. secretary (Mr. F. Ayton) is undertaking *pro tem.* until someone can be found who will accept the position. It was decided that, in future, dimensions for standards will be given in both metric and British measures, and that, in regard to the British measures, exact dimensions will be quoted in mils, while ordinary dimensions will be quoted in fractions. The secretary was instructed to bring this rule to bear in quoting dimensions of standards in the annual report of the Committee. Mr. E. W. Curtis, of the General Vehicle Co., was nominated as the Committee's representative upon the Tire and Road Wear Research Committee of the Society of Motor Manufacturers and Traders. The next meeting of the Committee was fixed for Friday, June 16th, at 2.45 p.m.

Fatalities.—At the resumed inquest held at Failsworth last week respecting the death of Ernest Capewell, who had been employed as a labourer at the works of Messrs. Ferranti, Ltd., and who had a mishap whilst lifting a carboy of nitric acid, the jury returned a verdict of "Death from misadventure."

Electrolytic Hypochlorite for Hospital Ships.—A report to the Medical Research Committee on the use of sodium hypochlorite prepared by the electrolysis of sea-water, for disinfecting and antiseptic purposes on shipboard, especially in hospital ships, has been made by Drs. H. D. Dakin and H. G. Carlisle, and was abstracted in the *British Medical Journal* of March 25th.

The report contains a description of apparatus installed on H.M.H.S. *Aquitania*, and is illustrated by scale drawings which would make it possible for any combination of doctor and engineer to introduce the method into any ship in which its use seems advisable. The electrolyser consists of a rectangular box of teak or cedar bolted together, and divided into 20 or 25 cells by means of carbon plates placed parallel to one another. Great care must be taken in the selection of the carbon plates, and a particular kind of graphite is recommended. Two wires leading the ship's current (100 to 110 volts direct current) are suitably connected through a switch with the electrolyser, which, to ensure even distribution of current, is provided with a copper plate attached to four binding screws at each end. If the voltage be 200 to 220, two electrolysers can be placed in series. Thanks are expressed to Dr. Edward Hopkinson, of Messrs. Mather & Platt, Manchester, for his assistance in constructing a practical and efficient apparatus, and apparently that firm is prepared to provide electrolysers.

When using ordinary sea-water, it is inadvisable to continue electrolysis for more than 10 minutes. In that time, with a current of 60 to 75 amperes at 110 volts, a solution will be obtained containing usually a little less than four parts per 1,000 of sodium hypochlorite or available chlorine. For most purposes it is advantageous to limit the electrolysis to five minutes, and at the end of that time the solution will contain from 2 to 2·7 parts per 1,000 of sodium hypochlorite or available chlorine. For swabbing floors, walls, latrines, &c., this may be diluted with an equal amount of water.

The results of the free use of hypochlorite in the wards were most gratifying. The general opinion, after the experience of two voyages to the Mediterranean, was strongly in favour of the hypochlorite as contrasted with phenolic disinfectants. In the typhoid and dysentery wards the results were particularly striking, and the absence of odour most marked. The most important effect, however, had been the large reduction in secondary infection occurring among the ship's staff.

The hypochlorite had also been used for the purification of the ship's drinking water. About 1 part in 1,000,000 was sufficient for all ordinary purposes, and the instability of electrolytic hypochlorite was so great that after three or four hours all traces of chlorine disappeared.

Electrolytic hypochlorite for surgical use should not be kept for more than 24 to 48 hours, but it can be so readily and cheaply prepared that this is not a matter of consequence.

The solution was also useful in the laundries and in the swimming bath on the *Aquitania*. No significant damage to ship structures was observed after two months' use.

The *Aquitania*, accommodating more than the seven largest London hospitals, gave Lieut.-Col. R. H. Fuhr full opportunity for forming a considered opinion, particularly as large numbers of dysentery and paratyphoid cases had been carried. The confinement of approximately 4,000 patients in a limited space rendered essential most stringent sanitary precautions, and Col. Fuhr states that he has satisfied himself that for efficiency, economy, and utility, electrolytic hypochlorite is very essential for hospital ships.

Engineering Equipment Required for Peking Government University.—With reference to the desire of the Chancellor of the Chinese Government University at Peking to obtain samples and models of engineering products of United Kingdom manufacture, it is notified that a well-known London firm of consulting engineers has been appointed to the office of honorary consulting engineers to the University, with a view to co-ordinating the equipment of the engineering school. The firm referred to (which holds a similar appointment with the Hong Kong University) has been instructed to prepare plans of the school of engineering, the equipment of which is to be proceeded with; a list of the apparatus required is being prepared, and the firm desires to get into communication with United Kingdom manufacturers who would be willing to present the necessary apparatus either free of charge or on specially favourable terms. The advantages which may be gained to British trade through Chinese students learning from samples and models of British make are obvious.

United Kingdom manufacturers who are prepared to assist in the manner indicated may obtain the name and address of the honorary consulting engineers on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*Board of Trade Journal.*

Engineering and Scientific Research.—At the meeting of the Society of Engineers (Inc.), on Monday next, a conference on the above-named subject will take place. It will be opened by Dr. J. A. Fleming, who has played a prominent and effective part during the war in directing attention to the nation's neglect of science, and to the handicap thereby imposed, not only upon our industries, but also upon our military efficiency. A large number of leading engineers and industrial authorities are expected to take part in the discussion.

In his paper, Dr. Fleming reviews the whole field indicated by the title, and indicates the nature of the reforms that are required in order to remedy the errors of the past.

The Board of Education has allocated £40,000 for scientific and industrial research, as compared with £25,000 last year.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. Ewart Bignell, who was installation superintendent at Sutton (Surrey), with the South Metropolitan Tramways Co., has resumed his duties after being invalided from the Army.

Worksop U.D.C. has appointed Mr. J. Fletcher, station superintendent, to take charge of the electricity works during the absence, on active service, of the electrical engineer, Mr. Crowther. His salary is to be increased by £25 a year.

The Southampton Electricity Committee proposes to advance the salary of the assistant mains engineer, Mr. F. G. Gilbert.

The Oldham Tramways Committee has recommended the appointment of Mr. P. Priestley, general manager of the Mexborough and Swinton Tramways Co., as manager of the Oldham Corporation Tramways. There were 47 applications.

The West Ham Corporation has been recommended to grant some small increases in the salaries of certain employés in the electricity department. In the case of the assistant engineers-in-charge it is proposed to raise the maximum salary payable to £2 10s., and in the case of the junior engineers-in-charge to £1 15s.

Mr. J. F. Cameron, manager of the Northampton Tramways, while attending to repair work at the generating station last week-end, stepped in the darkness into a 6-ft. inspection pit. Mr. J. Cottier, who went to Mr. Cameron's assistance, fell into the pit on the top of the manager. He escaped with slight injuries, but Mr. Cameron had two ribs broken.

Having regard to the extra duties imposed upon the tramways manager consequent upon the Leyton District Council's resolution not to insure against third party risks, it is proposed to increase his salary from £400 to £425 per annum, rising by annual increments of £25 to a maximum of £500.

The Luton Town Council has been recommended to increase the salary of the assistant electrical engineer, Mr. H. A. Kell, from £200 to £215 per annum, and that of the chief technical assistant, Mr. A. H. Gates, from £182 to £200 per annum.

General.—The Executive Committee of the City and Guilds of London Institute have appointed Prof. Gilbert T. Morgan, D.Sc., F.R.S., of the Royal College of Science, Dublin, to the Chair of Chemistry at the Institute's technical college, Finsbury, rendered vacant by the death of Prof. Meldola.

A correspondent says that Mr. Walter Pilling, who has been a member of the Rochdale T.C. since 1903, and is an Alderman, has sent in his resignation. It is understood that his action is due to his dissatisfaction with the methods of the Electricity Department in connection with the supply of electricity to certain mills in which he is largely interested.

An agreement has been concluded with Mr. Clifford C. Paterson, M.I.E.E., A.M.I.C.E., principal assistant in charge of electro-technical and photometric buildings at the National Physical Laboratory, to join the Osram-Robertson Lamp Works, Ltd., as director of laboratories for research and technical manufacturing purposes. The arrangement will commence at the conclusion of the war, or before that date if possible.

Mr. H. P. Gibbs, consulting electrical engineer to the Mysore Government, and general manager of the Tata hydro-electric scheme in Bombay, is shortly returning to the United States on long leave, *vid* Australia and Vancouver.—*Indian Engineering.*

The *Commonwealth Engineer* states that in consequence of a protest by the Professional Officers' Association of the Commonwealth Postmaster-General's Department against the appointment of imported officers over the heads of Australians, a competitive examination was recently held for the position of electrical engineer for the telephone branch at Adelaide. The salary is £528 per year. Mr. R. Lawson, formerly assistant engineer on the staff of the chief electrical engineer, and who was one of the imported officers, was selected. Mr. P. Kennedy, of Western Australia, gained second honours.

Mr. Ernest Hardman was married at Blackpool, on April 19th, to Miss Ethel A. Service. An aneroid barometer was presented by the staff and employés of the Yorkshire Electric Power Co. Mr. Hardman is a charge engineer at the Barnsley power house of the Yorkshire Co. The barometer was presented on behalf of the entire staff by Mr. H. F. G. Woods, resident engineer. Mr. Geo. Sheppard, who acted as best man, is a colleague of Mr. Hardman's.

Roll of Honour.—At a meeting of the Salford Tramways Committee on April 18th, Ald. Worsley (Deputy-Mayor) presented to Sergeant W. R. Smethurst, of the Royal Sussex Regiment, the D.C.M., which has been awarded to him for conspicuous gallantry in the field. Smethurst was for several years employed as a motor-man in the Salford tramways

department. He was also handed an illuminated copy of a resolution of congratulation on his distinction, which was passed by the Tramways Committee.

Lance-Corporal Herbert Harvey, of the Royal Fusiliers, formerly engaged at the West Ham electricity works, who has been missing in Flanders since October, 1914, is now officially reported killed in action.

Lieutenant H. A. Clifton, of the East Lancashire Regiment, who has fallen in action whilst serving with the Kut relieving force in Mesopotamia, was, before the war, engaged as an electrical engineer at Woolwich, with Messrs. Siemens Bros.

The *Times* records that Second-Lieutenant James Clement Smith, Royal Fusiliers, an electrical engineer, was killed at the Front on March 27th. He joined the Public Schools Battalion of the Middlesex Regiment shortly after war broke out.

Second-Lieutenant T. O. H. Bates, A.M.I.E.E., of the 89th Punjabis, late chief electrical engineer to the Tata Steel & Iron Co., Bombay, died on April 12th of wounds received in action. Prior to his appointment in India, he held the position of engineer-in-charge at the Morley Corporation electricity works, and also that of electrical engineer at the Rotherham Main Collieries.

Lance-Corporal R. David, formerly an assistant at the Bristol depôt of the Edison & Swan Co., Ltd., has received a letter from the Divisional Officer on active service referring to his distinguished conduct in the field on March 19th and 20th, 1916.

Obituary.—Mr. J. Stott.—We regret to record the death of Mr. Jones Stott, for 12 years manager of the Heywood Corporation electricity works. He was 42 years of age, and three years ago resigned his appointment on account of failing health. Death was due to heart failure.

NEW COMPANIES REGISTERED.

N. E. C. T. A., Ltd. (143,669).—This company was registered on April 19th as a company limited by guarantee, but having a share capital of £4,000 in £1 shares (2,000 6 per cent. cumulative preferred). Each member undertakes to contribute not more than £1 in the event of winding-up. To enter into contracts (a) to obtain special trade discounts on the purchases or dealings of members or others, and (b) to indemnify clients of members or others against the supply of faulty workmanship or materials; to carry on, as principals or agents, the business of manufacturers, repairers, commission agents, contractors or dealers in electrical machinery, instruments, appliances, wires, cables, accessories, and apparatus, electricians, electrical, gas, mechanical, or general engineers, &c. The subscribers (with one pref. share each) are: W. Cross, 7 & 9, Ridley Place, Newcastle, electrical engineer; P. Collinson, 3 & 5, Millergate, Bradford, electrical engineer; H. Marryat, 28, Hatton Garden, E.C., electrical engineer, J. Orringe, 24, Belvoir Street, Leicester, electrical engineer; W. R. Rawlings, 82, Gloucester Road, S.W., electrical engineer; W. A. Shaw, 107, Princes Street, Stockport, electrical engineer; S. H. Webb, 15, Cank Street, Leicester, electrical engineer Minimum cash subscription, seven shares. The management is vested in a council, which shall consist of such persons who are existing members of the Central Board of the Electrical Contractors' Association (Incorporated) as shall consent to be members of the company, and act thereon. The first are W. Cross, P. Collinson, H. Marryat, J. Orringe, W. R. Rawlings, W. A. Shaw and S. H. Webb. Secretary: L. G. Tate. Registered office: 20, Bucklersbury, E.C.

Mitcham Rubber Co., Ltd. (143,592).—Registered April 13th, by Lumley & Lumley, 15, Old Jewry Chambers, E.C. Capital, £50,000 in £1 shares. Objects: To carry on the business of india-rubber, asbestos, gutta-percha, flax hose, flax and cotton belting, lawn tennis, and ship and engineers' stores, manufacturers and dealers, electricians, telegraph and electrical engineers and contractors, submarine and other cable and telegraph instrument manufacturers, wire drawers, wire rope makers, manufacturers of and dealers in pneumatic and other tires, and wheels of cycles, carriages, and vehicles of all kinds, &c. The subscribers (with one share each) are: R. M. Albery, Coombe Hill Road, East Grinstead, Sussex, gentleman; E. W. Hopton, Furzedown, 74, Crowborough Road, Tooting Common, cashier; H. C. Bouttell, 3, Ermine Road, Lewisham, S.E., clerk; F. Hopkins, 12, Holmewood Road, South Norwood, Surrey, secretary; E. H. Taperell, 20, Chester Road, West Green, N., clerk; J. E. Anstey, 31, Barcombe Avenue, Streatham Hill, S.W., clerk; F. G. Mathews, 116, Pendle Road, Streatham, S.W., clerk. Minimum cash subscription, 7 shares. The first directors (to number not less than three or more than seven) are to be appointed by the subscribers. The directors shall have the right to appoint "departmental directors." Qualification, 250 shares. Remuneration (except departmental directors), £100 each per annum, and 10 per cent. of the net profits, divisible (maximum additional remuneration, £5,000). Solicitors: Lumley & Lumley, 15, Old Jewry Chambers, E.C.

Troughton & Simms, Ltd. (143,586).—This company was registered on April 12th, with a capital of £21,200 in £1 shares, to take over the business of mathematical instrument makers carried on by W. Simms and J. Simms, at 138, Fleet Street, E.C., and 340, Woolwich Road, Charlton, as Troughton & Simms, and to carry on the same and the business of astronomical instrument makers, manufacturers of instruments connected with land survey, electrical, and other scientific apparatus, &c. The subscribers (with one share each) are: W. Simms, 132, Shooters Hill Road, Blackheath, mathematical instrument maker; J. Simms, Craighead, Abbey Wood, Kent, mathematical instrument maker. Private company. The number of directors is not to be less than two or more than five; the first are W. Simms, J. Simms, and A. D. Simms. The first two named are permanent joint managing directors, subject to holding £5,000 shares each, with £1,200 per annum respectively. Qualification of A. D. Simms, 500 shares. Registered office: 340, Woolwich Road, Charlton.

Precision Screw Co., Ltd. (143,612).—This company was registered on April 14th, with a capital of £3,000 in £1 shares (2,000 pref.), to carry on in the United Kingdom or elsewhere the business of manufacturers of screws, particularly screws and parts for electrical and scientific instruments and small engineering and scientific apparatus, &c., and to adopt an agreement between E. Homberger and F. E. Collinson. The subscribers (with one share each) are: F. E. Collinson, 7, Hempstead Road, Walthamstow, N.E., instrument manufacturer; E. Homberger, 9, Hempstead Road, Walthamstow, N.E., engineer. Private company. The number of directors is not to be less than two or more than five; the first are E. Homberger and F. E. Collinson (both permanent, subject to holding £500 shares). Registered office: Provost Works, Macdonald Road, Walthamstow.

Anchor Electric Co., Ltd. (143,676).—This company was registered on April 20th, with a capital of £4,100 in £1 shares (1,700 10 per cent. cum. pref.), to take over the business of electrical engineers, manufacturers of electrical apparatus, fittings, and batteries, being a portion of the business carried on by A. Richmond and T. T. Rankin, C.E., B.Sc., M.I.M.M., M.I.M.E., at 81, Cannon Street, E.C., together with the benefit of the experiments made and secret processes used by the proprietors. The subscribers (with one preferred share each) are: A. Richmond, 81, Cannon Street, E.C., electrical engineer; T. T. Rankin, 81, Cannon Street, E.C., electrical engineer. Private company. The number of directors is not to be less than two or more than seven; the first are A. Richmond and T. T. Rankin (both permanent). Qualification (except first directors) £100 shares. Remuneration, £50 each per annum. Registered office: 81, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Derby Lamp Works, Ltd.—Second mortgage debenture dated March 30th, 1916, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital. Holder: W. L. T. Arkwright, Caxton House, Westminster.

Charing Cross, West End & City Electricity Supply Co., Ltd. (29,122).—Capital, £2,100,000 in 130,000 pref., 130,000 ord., 80,000 City Undertaking pref., and 80,000 City Undertaking ord. shares, all of £5 each. Return dated March 23rd, 1916. 80,000 pref., 80,000 ord., 80,000 City Undertaking pref. and 70,000 City Undertaking ord. shares taken up. £1,200,000 paid on the pref., ord., and City Undertaking pref.; £350,000 considered as paid on the City Undertaking ord. Mortgages and charges: £1,087,178.

Clarke, Chapman & Co., Ltd. (39,045).—Capital, £250,000 in 18,000 ord. and 7,000 pref. shares of £10 each. Return dated March 7th, 1916. 15,281 ord. and 6,985 pref. shares taken up; £10 per share called up on 3,536 ord., £2 10s. on 200 ord., and £10 on 4,435 pref.; £80,210 paid; £152,450 considered as paid, being £10 per share on 11,545 ord., £7 10s. on 200 ord., and £10 on 2,550 pref. Mortgages and charges: £100,000.

Crossley Bros., Ltd. (51,970).—Return dated March 9th, 1916. Capital at date of return, £973,700 in 40,339 pref. and 57,031 ord. shares of £10 each. All shares taken up; £278,200 paid on 27,820 pref.; £695,000 considered as paid on 12,519 pref. and 57,031 ord. Mortgages and charges: Nil. On March 14th, a resolution was confirmed sub-dividing each £10 share into ten £1 shares.

Asbestos and General Paint Co., Ltd. (formerly Asbestos Fireproof Paint Co., Ltd.).—A notice of the appointment of H. E. Moore, of 41, Bedford Row, W.C., as receiver and manager by Order of Court dated April 12th, 1916, filed pursuant to Section 94 of the Companies (Consolidation) Act, 1908.

Newton & Wright, Ltd.—Land Registry Charge on certain land in Islington, dated March 27th, 1916, to secure all moneys due or to become due from company to Union of London & Smiths Bank, Ltd., 455, Oxford Street, W.

G. H. Turner & Co., Ltd.—A memorandum of satisfaction in full on April 14th, 1916, of second debs., dated April 21st and July 12th, 1915, securing £100, has been filed.

CITY NOTES.

Brush Electrical Engineering Co., Ltd.

Mr. E. Garcke presided at the annual meeting on April 18th. He said that, despite the many difficulties of the past year, they had maintained the improvement of recent years. In fact, the gross profits were a little larger, being £61,800, as against £60,800 in 1914, but general charges had been £1,200 higher, and £1,200 more had been spent on maintenance and plant and buildings; so that the net distributable profits for 1915, after paying debenture interest, were £17,300, compared with £19,100 in 1914. Out of this they proposed to write off for depreciation £8,000, to put £5,000 to reserve, to pay an extra 4 per cent. on the second prior lien loan debenture stock, which would require £2,000, and would make a return of 10 per cent. for the year on this stock, and then to increase the carry forward by £2,200, which would then stand at £9,321, equal to about 9 per cent. of the share capital. During the year they had spent £31,962 on capital account in connection with Government contracts on which they were engaged. This expenditure was anticipated and referred to last year, and it was then stated that they would have to issue the balance of the second prior lien debenture stock in order to provide the necessary funds. They had obtained the consent of the Treasury to make the issue. In view, however, of the fact that they were paying 10 per cent. per annum on this stock, and that the present was not a good time to make issues of capital on the most favourable terms, they were postponing this issue as long as possible. Meanwhile, they were utilising their profits and temporary loans to provide the cash for capital expenditure. That was obviously better finance than to raise capital at a high cost in order to pay dividends, and the directors were glad that the shareholders at the last meeting approved the course recommended not to commence the payment of dividends on share capital during the war. They might, however, have to issue some more debenture stock, although they would postpone doing so as long as possible. In addition to other things, they had turned out a large quantity of transport material as well as turbo-generators, motors, and transformers. Although the net profits had not been quite up to those of the previous year, due to the fact that they had to some extent had to bear the brunt of higher wages and a largely enhanced cost of materials, it was satisfactory to feel that their work had

been of national importance. With regard to the Ljungstrom turbine, the performance of this machine continued to be highly satisfactory. Naturally, some of the directions in which they looked for orders for this class of plant were closed for the time being, and development had to some extent been retarded, but during the year they had provided Ljungstrom sets to the Government and munition works, as well as to electricity supply stations and industrial undertakings, and in every case with gratifying results. Ljungstrom sets of larger size were now in course of installation. Orders were in course of execution for Japan and New Zealand. Whilst, as he had already said, the home market was at present necessarily restricted, the Swedish Ljungstrom Co. had made phenomenal progress, and found itself for the time being unable to cope with the demand which had arisen for turbines of this design. The figures representing the output of turbines by the parent company, as well as the Brush Co., were really very remarkable. It now amounted to 133,000 KW., thus showing that the Ljungstrom turbine had passed completely out of the experimental stage. Their own arrangements for the manufacture of this turbine, with its auxiliaries, on a more extended scale, were well forward, and would have been complete in normal circumstances long before this, but owing to the abnormal conditions prevailing, the delivery of some of the new machine tools on order had been unavoidably delayed. However, they were already reaping some of the benefit they hoped ultimately to enjoy by the installation of this new tool equipment, and he hoped that before long tools for the whole sequence of their manufacturing operations would be available.

Mr. B. S. Broadhurst (managing director) seconded the motion, and the report was adopted without discussion.

South Metropolitan Electric Light and Power Co., Ltd.

At a meeting of debenture stockholders held on April 19th, Mr. H. R. Beeton presiding, a resolution was passed making certain modifications in the provisions of the trust deeds in order to more clearly define the obligations of the company thereunder with regard to setting aside sums to depreciation, &c., and, according to the *Financial Times*, to put an end to questions which have arisen. Mr. Beeton said that his co-trustee and himself believed that the resolution would enhance the credit of the company and contribute to the prosperity which, he felt sure, they all agreed was now fully assured. The chairman of the company seconded the resolution.

Cuba Submarine Telegraph Co., Ltd.

The total receipts for 1915 were £45,312, and the expenses were £29,121, leaving £16,190, plus £7,891 brought forward. Several of the cables were seriously affected by earthquakes, cyclones, and other causes during the year, necessitating heavy expenditure both of cable and for steamer hire in repairing same, amounting to £13,655, which has been charged against revenue. £2,500 has been placed to pension fund, and after paying 10 per cent. on the preference shares, less income-tax, and 5 per cent. on the ordinary shares, free of income-tax, £7,581 is to be carried forward. Annual meeting: May 3rd.

Johnson and Phillips, Ltd.

The profit for 1915 on trading accounts, &c., after making provision for bad and doubtful debts, and after charging to revenue upwards of £9,000 for maintenance of buildings, plant, &c., was £69,084, plus £24,296 brought forward, less the dividend paid in April, 1915, £8,750. Remuneration of directors, &c., absorbs £1,958; debenture interest £5,727; debenture sinking reserve fund £7,182; second debenture interest £2,500; depreciation on machinery and plant, &c., £12,149; interest on loan £1,063; reserve account £20,000, to meet contingencies in connection with the war; leaving available £34,050. After paying 5 per cent. dividend on the ordinary shares, £8,750, £25,300 is to be carried forward. The business has been a "controlled establishment" since August last. Annual meeting: Yesterday.

Oriental Telephone and Electric Co., Ltd.

The gross earnings for the year 1915, including dividends and interest from subsidiary companies, amounted to £90,631, plus £15,481 for payments made under the deed of compromise dated June 9th, 1915, and the balance brought forward £56,136, making £162,248. Working expenses, maintenance, &c., absorbed £38,655, depreciation of securities £5,500, interim dividends, debenture interest, and redemption charges £18,368, leaving £99,726. After paying the final dividends of 3 per cent. on the preference and 6 per cent. (making 10 per cent.) on the ordinary shares, £70,000 is transferred to reserve account, £2,000 to staff pension fund, and £15,467 is to be carried forward. The exchanges worked by the company continue to expand and show improved revenues. Underground cabling extensions are in progress at Singapore and Madras, from the operation of which additional revenue will accrue to the company. The Indian local companies show considerably increased revenues for the past year. The Bengal Telephone Co., Ltd., has paid the same dividend as for 1914, viz., 7 per cent. In order to provide permanent quarters for increasing business, the directors of that company have decided to purchase a central site in Calcutta, and intend to erect a suitable building thereon, in which will be installed a new switchboard equipment. Additional share capital will be issued to meet the necessary expenditure, and this company will take its proportion of the issue. The Bombay Co. has paid a dividend of 20 per cent., as against 16 per cent. for 1914. The amount of the dividend in both instances has been included in the accompanying revenue account. Both the Telephone Co. of Egypt, Ltd., and the China and Japan Telephone & Electric Co., Ltd., have had a satisfactory year: the former continues to pay the previous rate of dividend of 10 per cent., and the latter 10 per cent., as against 5 per cent. for 1914, which have also been brought into the revenue account. The annual meeting was held on Wednesday.

Potteries Electric Traction Co., Ltd.

The capital expended during 1915 was £532. The revenue was £136,167, the traffic receipts at £119,872 showing an advance of £4,789. After deducting expenses, including £11,269 for debenture and other interest, the balance is £40,872, as against £35,825 for 1914. There is to be placed to reserve £8,035, and to renewals £10,000; preference dividend 5 per cent., requires £12,250; 3 per cent. dividend on the ordinary shares amounts to £7,350, and £4,935 is to be carried forward. The reserve now stands at £36,824, and the renewals account at £35,738. The tramway and omnibus receipts for the second half of the year showed satisfactory increases. Owing to labour shortage through the war, working conditions were exceedingly difficult. The negotiations with the Stoke-on-Trent Corporation for the postponement by the Corporation for a definite period, of their rights to purchase certain portions of the company's undertaking, have not so far resulted in agreement. Annual meeting: May 1st.

Willans and Robinson, Ltd.

For the year 1915 there was a net profit of £16,726, after payment of debenture interest, provision for depreciation of plant and machinery and revaluation of stocks, allowances to employés on active service, as well as special provision on account of outlays and commitments arising from war conditions. The company was among the first to become a "controlled establishment" under the Munitions of War Act, 1915, *i.e.*, from July 12th last. During the year the Queen's Ferry works were disposed of. In 1913 the majority of the ordinary shares were acquired on terms by interests whom Mr. H. Barber represented. An opportunity has arisen by transfer of the greater part of such interests of introducing additional parties. The directors consider this will be advantageous to the company's interests, and a resolution confirming the conditional release of Mr. Barber from his covenant not to transfer the shares will be submitted to the shareholders for approval at the meeting today. Warrants will be issued covering the dividends on "A" and "B" preference stocks, and interest on the funding certificates. A dividend for the year of 10 per cent. on the ordinary shares is recommended, leaving a balance of £8,776. Of this, it is proposed to carry £7,099 to the reserve fund, and to distribute £1,677 among the holders of "B" stock and ordinary shares in manner provided by the Articles.

Urban Electric Supply Co., Ltd.

Mr. P. D. Tuckett, presiding at the annual meeting on April 12th, referred to the effect of the drastic lighting restrictions and of consumers' economy on the lighting revenue, also to the heavy increase in cost of materials, especially coal, which was up by £8,868, or about 30 per cent., while the quality was often inferior to that of similar class coal prior to the war. They had been deprived of the services of many of their most experienced and highly-trained men at a time when they could least afford to lose them. Over 150 men had enlisted, and allowances had been made. Considering all these adverse circumstances, it was fortunate that they had so little less profit than a year ago. Both the profits earned at the various works and the net profit balance were less than £500 below the 1914 figures. They had placed £9,389 to reserve for depreciation, as against £10,904 in 1914. The item investments now stood at £178,531, as a large part of their advance to the Cornwall Co. had been converted into shares of that company. They had connected the equivalent of an additional 83,986 lamps, a 10 per cent. increase, of which 83 per cent. represented power, a much larger proportion than in previous years. These additional connections had entailed a capital expenditure of £31,846, which was largely met from the proceeds of the Cornwall Co.'s debenture issue made last May. This year new connections and capital expenditure would be materially reduced, as they were not in a position to finance any large developments in these difficult times. In regard to their different undertakings, Hawick and Grantham had largely saved the situation, the former owing to the activity of its mills, and the latter owing to its military camp. Glossop and Twickenham showed useful increases of £700 and £800. He very much hoped that Twickenham, with its largely increased power load, to provide for which the greater part of last year's capital expenditure was incurred, would show a further large increase of profit during the year, for he feared that it might be the only undertaking from which they would receive any considerable increase, most of the others being likely to be increasingly affected by the adverse conditions already mentioned, and particularly by the increase in the price of coal, which was now substantially higher than last year's figure; indeed, the difficulty had been to get coal at all. The whole situation was a most anxious one for all large coal-users, and he doubted whether there was much prospect

of any material relief whilst the war lasted. They had been reluctantly compelled in a good many instances to make some increase in their rates of charge, but how far it would compensate them it was impossible to forecast, for it was one of the peculiar characteristics of the business that, owing to the altogether disproportionate ratio which capital and standing charges bore to running costs, a rising or falling revenue was not accompanied by a corresponding increase or decrease in the costs of production. In other words, loss of revenue largely represented loss of profit, just as an expanding revenue largely represented increased profit. It was a most satisfactory feature in normal times, and a correspondingly unsatisfactory one in abnormal times. It had been a great disappointment that the Cornwall Co.'s extremely gratifying progress should have been interrupted so unfortunately, but it was directly attributable to the war conditions, and particularly to the fact that half the active mining population had gone to the Front, where their expert knowledge was no doubt of the utmost value in trench warfare. The increased demand for power, which the various war activities had brought about, and which had been a marked feature of the year, had materially contributed to prevent the results shown by several of the towns being worse than they were, whilst Stamford and Twickenham's improved results were almost entirely due to increased power load. Amongst the many uses to which the supply of power was being directly put for the purposes of the war were the manufacture of shells, grenades, fuses, stretchers, motors, motor cycles, motor lorries, and propellers, whilst wolfram from the mines supplied by this company in Cornwall constituted a most important element in the manufacture of high-class steel. With their street and shop lighting practically gone for the time being, and with lighting consumers generally economising, the lighting revenue, in spite of additional connections, was in many cases substantially reduced; and when they combined with this an abnormal war expenditure of some £11,000 or £12,000 it was not at all surprising that some of the towns showed worse results than for the previous year. Speaking broadly, the towns which had suffered most had been those which were most largely dependent on a lighting load, such as Weybridge, whilst the towns which had benefited most were those with an industrial population and a power load like Hawick. Glossop's improved profit was almost entirely due to the improved earnings of its tramway, which had greatly benefited by the prosperity of the industrial population it served.

River Plate Electricity Co., Ltd.

The report for 1915 states that the net revenue, after providing for administration expenses, bad debts, and all necessary depreciations, amounts to £38,713, plus £20,513 brought forward, making £59,226. The board proposes a dividend of 7 per cent. for the year on the ordinary stock, to set aside as special provision for bad debts £5,000, income-tax £5,000, and to carry forward £18,387. The persistence of unfavourable trading conditions in the Argentine, aggravated by the prolongation of the European war and the great rise in freights and cost of materials, has, as in the previous year, adversely affected the net results. The continuance of hostilities has also prevented the payment of interest upon the 5 per cent. obligations of the German Trans-Oceanic Electric Co., of Berlin. It has likewise prevented the eighth annual payment of £2,300 due upon April 1st, 1916, on account of the amortisation of the 5 per cent. obligations being made. No dividend is included in the year's receipts upon the 21,000 £1 shares of the Argentine Electricity Co., received in connection with the sale of Tucuman, but upon the issue of that company's report, due shortly, it is expected that a small dividend will be declared. The important capital improvements and extensions at Ensenada and La Plata in progress during the last two or three years are now satisfactorily completed. No further capital expenditure of any moment is in contemplation. The further 25,000 £1 preference shares and 25,000 £1 ordinary shares issued in 1914 are now fully paid and have been converted into preference stock and ordinary stock.—*Financial Times.*

Calcutta Tramways Co., Ltd.—The revenue, including interest on investments and deposits, less interest on loans, and the balance brought forward of £7,566, amounts to £116,736. A final dividend of 6s. 6d. per share is proposed, making 9¼ per cent. for the year, transferring to reserve for depreciation, &c., £15,000, contribution to staff provident fund £1,309, leaving to be carried forward £6,812.

Colombo Electric Tramways and Lighting Co., Ltd.—The directors announce a dividend of 10 per cent., free of tax, for 1915; £15,000 is put to general reserve and renewal fund, which has been dealt with by writing off £3,000 from the special renewal fund, and £8,165 is carried forward.

Bath Electric Tramways, Ltd.—The accounts for 1915, after providing for the preference dividend and sinking fund instalment, show an available balance of £8,486, which the directors recommend (says the *Financial Times*) should be carried forward to augment the reserves available for the purposes of depreciation and renewals.

Rees Roturbo Manufacturing Co., Ltd.—The available profit for 1915 is £30,419, of which £8,000 is put to depreciation and £12,000 to reserve, £10,419 being carried forward.

An Austrian Cable Works.—The Felten & Guilleaume A.G., of Vienna, reports gross profits of £145,000 for 1915, as contrasted with £106,000 in the preceding year. After defraying general expenses and making provision for depreciation, the accounts show net profits of £105,000, as against £57,000, and a dividend is proposed at the rate of 12 per cent., as compared with 10 per cent. in 1914. The prospects for the current year are declared to be favourable, as work is on hand for a long time forward, both in the electrical works at Vienna and the iron and steel works in Styria.

Capital Reduction.—*British Uralite Co.* (1908), *Ltd.*—A petition for confirming the reduction of capital from £142,500 to £91,875 is to be heard on May 9th.

Montreal Light, Heat and Power Co.—A dividend of 2½ per cent. is announced for the quarter ended April 30th.

Kaministiquia Power Co.—A dividend of 1½ per cent. has been declared for the quarter ended April 30th.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange has scarcely got back into its full swing of business, and the influence of the Easter holidays remains apparent in most of the markets. The political crisis of last week had no effect upon quotations, and the only effect which such matters are having upon the world of finance is to be seen in New York, where prices came down sharply upon the innocent statements as to another last Note to Germany. In the electrical sections, the principal feature is the further progress of telegraph stocks and shares. It is extremely difficult to get the offer of any reasonable amount, and other groups outside the Eastern have begun to share in the strength initiated by the dividends recently declared by the latter.

The good prices reached by the Underground Electric stocks have barely been maintained, though the market in them as a whole is not a bad one. There is considerable curiosity felt as to the reason for the still-unexplained rise in Metropolitan Consolidated stock, which gained another point just before the holidays. Districts keep steady, but Underground Electric income bonds eased off a trifle.

Many people are asking whether they are entitled to claim income-tax in respect of the Electric Underground income coupons, seeing that these are paid free of tax, which is deducted by the company before it distributes the dividend. Those people, however, who are entitled to relief should apply to the bank for an income-tax certificate when they are presenting their coupons for payment; and the bank will hand them a certificate somewhat similar to that which is given in cases where dividends are paid less tax, this certificate being accepted as a voucher by the Inland Revenue authorities, as entitling the holder of it to claim what may be due to him.

We believe that some little question arose between the bankers, the Underground Electric Railways Co., and the Inland Revenue authorities as to the proper procedure to be employed in this case; but the points of difference have now been adjusted satisfactorily, and, as we have already said, bondholders who are entitled to return of tax should ask for a voucher at the time they present their coupons.

Eastern ordinary has followed up its 9 points rise of last week with a further advance of 2½, and the improvements in "China" and Western Telegraph shares have been carried further. Indo-Europeans are good at 52, on the declaration of the usual dividend of £2 12s. 6d. per share, making 65s. for the year, the announcement being couched in an unusual way. Instead of this dividend being declared as the final for the year, the company calls it an interim dividend, which naturally gave rise to some hope that there might be a little extra to come when the year's accounts could be made up and properly adjusted. Apparently, the company has not yet received its final accounts for the year from the various outlying parts of the world which it serves; and it may be, of course, that the present interim dividend may also prove to be the final in respect of 1915.

Electricity supply shares are distinctly better, there being rises in nearly half-a-score of the leading issues. It would appear as though this department, the Cinderella of the industrial market, were at last to receive a little attention from investors, and that the attractions held out by good yields were not to be entirely overlooked, after all. For improvement to come in the shares of illumination companies just when the days are growing long is a novelty. We have mentioned from time to time recently that shrewd people have been trying to get the offer of shares, but without meeting any noticeable success; evidently some of the inquiries have crystallised into transactions, for the supply of stock now on offer in the market is more than usually limited. At the same time, it has to be borne in mind that the market is at all times a narrow one, and that it takes comparatively little either of demand or supply to cause prices to move.

Some of the manufacturing shares are better, too. Edison and Swan (£3 paid) have risen a florin. Electric Constructions are 6d. up, and General Electrics gained ¼. India-Rubber shares, still called "Silvers" in the Stock Exchange,

are 10s. better at their par value of £10. Cable manufacturing shares, as a whole, have followed the lead set by the cable market; and Henleys at 14½ are ex the dividend of 17s. 6d., therefore showing a net gain of ⅜ on the week. The only exception to the strength of this section is a fall of 1/16 in British Westinghouse preference. Most of the chemical shares are good; Castner-Kellners, for instance, at 3¼ are 2s. 6d. up.

Brazil Tractions are quoted ex a dollar dividend this week, allowing for which the price is 2½ higher. The Stock Exchange calculates that the company may now be regarded as upon a 4 per cent. basis, so far as the common shares are concerned; so that at the present price the return works out to about 7¼ per cent. on the money. The Colonial and foreign shares as a whole are steady, Mexicans once more having sunk into suspended stagnation. The movements of the American troops on the frontier, and in Mexico itself, are watched with a languid interest; and President Wilson, deep in the throes of another Note to Germany, cannot be expected to find time to deal with such a trifle as Mexican settlement.

The rubber market keeps firm, and the steady outpouring of excellent Spring dividends and reports is sufficient to command the attention, interest, and money of a wide circle of speculative investors. The price of the commodity does little to help values, but nowadays this is treated with comparative indifference, seeing that were rubber to drop to half-a-crown per lb., most of the producing concerns would still make large profits. In the metal markets, copper shares are mostly strong, but there is not much doing in these; while the armament division is disposed to be a trifle heavy.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price April 25, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅞	—	£7 8 2
Charing Cross Ordinary	5	5	3½	—	7 13 10
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 6
Chelsea	5	4	1½	—	6 8 1
City of London	9	8	12	+ ⅛	6 13 4
do. do. 6 per cent. Pref.	6	6	10½	+ ⅛	5 17 1
County of London	7	7	10½	+ ⅛	6 13 4
do. 6 per cent. Pref.	6	6	10½	+ ⅛	5 17 1
Kensington Ordinary	9	7	5	—	7 0 0
London Electric	4	3	1⅜	+ ⅛	7 6 4
do. do. 6 per cent. Pref.	6	6	4½	+ ⅛	7 1 2
Metropolitan	3½	3	2⅝	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	10	8	6	+ ⅛	6 13 4
South London	5	5	2⅝	—	8 13 10
South Metropolitan Pref.	7	7	1 1/16	—	6 14 0
Westminster Ordinary	9	7	6	+ ½	5 16 8
Telegraphs and Telephones.					
	Dividend, 1914.				
Anglo-Am. Tel. Pref.	6		99	+ ⅛	6 1 3
do. Def.	33/6		21½	+ ⅜	7 18 6
Chile Telephone	8		6⅝	—	6 5 6
Cuba Sub. Ord.	5		7⅞	—	6 9 0
Eastern Extension	7		14½	+ ½	*5 12 4
Eastern Tel. Ord.	7		142½	+ 2½	*5 12 4
Globe Tel. and T. Ord.	6		11⅛	+ ⅛	*5 4 4
do. Pref.	6		10⅝	+ ⅛	5 18 5
Great Northern Tel.	22		35½	— ⅛	6 4 3
Indo-European	13		52	—	6 5 0
Marconi	5		2⅛	+ 1/16	4 9 0
New York Tel. 4½	—		100⅞	—	4 9 4
Oriental Telephone Ord.	10		1⅝	—	5 6 8
United R. Plate Tel.	8		6	—	*6 13 4
West India and Pan.	1		1⅜	+ 1/16	9 1 10
Western Telegraph	7		14½	+ ½	*5 12 4
Home Rails.					
Central London, Ord. Assented	4		67½	—	5 8 6
Metropolitan	1½		26¼	+1½	3 15 6
do. District	Nil		19⅛	—	Nil
Underground Electric Ordinary	Nil		1⅜	—	Nil
do. do. "A"	Nil		6/-	—	Nil
do. do. Income	6		83½	— ½	*6 19 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6		4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½		3¾	—	7 6 8
do. 2nd Pref.	5½		3⅝	—	8 3 0
do. 5 Deb.	5		78	—	6 8 2
Brazil Tractions	4		65½ xd	+2½	7 4 2
Bombay Electric Pref.	6		10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5		53	—	9 8 8
do. do. Preferred	—		37	—	Nil
do. do. Deferred	—		23	—	Nil
do. do. Deb.	4½		62 xd	—	6 17 1
Mexico Trams 5 per cent. Bonds	—		40	—	Nil
do. 6 per cent. Bonds	—		12	—	Nil
Mexican Light Common	Nil		20	—	Nil
do. Pref.	Nil		32	—	Nil
do. 1st Bonds	—		39	—	—
Manufacturing Companies.					
Babcock & Wilcox	14		23	—	5 1 8
British Aluminium Ord.	5		22/- xd	—	6 7 3
British Insulated Ord.	15		10½	—	7 2 10
British Westinghouse Pref.	7½		2 1/16	— 1/16	7 5 2
Callenders	15		11½	—	6 10 5
do. 5 Pref.	5		4½	—	5 17 8
Castner-Kellner	20		3½	+ ⅛	6 3 0
Edison & Swan, £3 paid	Nil		9	+2/-	Nil
do. do. fully paid	Nil		1½	—	Nil
do. do. 5 per cent. Deb.	5		57	—	8 15 8
Electric Construction	6		16/-	+6d.	7 10 0
Gen. Elec. Pref.	6		9⅜	+ ⅛	6 4 8
Henley	20		14⅜	+ ⅜	*6 18 0
do. 4½ Pref.	4½		4	—	5 12 6
India-Rubber	10		10	+ ⅛	*10 0 0
Telegraph Con.	20		85½	—	*6 18 4

* Dividends paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 26th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	per ton	£70	..
a Ammonia, Muriate (large crystal)	per ton	£54	..
a Bisulphide of Carbon	per ton	£23	..
a Borax	per ton	£28	..
a Copper Sulphate	per ton	£19	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	per lb.	2/-	..
a Shellac	per cwt.	95/-	..
a Sulphate of Magnesia	per ton	£18	..
a Sulphur, Sublimed Flowers	per ton	£14	..
a ,, Lump	per ton	£9	..
a Soda, Chlorate	per lb.	1/4½	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/4½ to 1/4¾	⅛d. inc.
c ,, Tubes (solid drawn)	per lb.	1/5½ to 1/5⅝	..
c ,, Wire, basis	per lb.	1/4¾ to 1/5	⅛d. inc.
c Copper Tubes (solid drawn)	per lb.	1/7 to 1/7⅛	d. to¾d.inc.
g ,, Bars (best selected)	per ton	£154	£6 inc.
g ,, Sheet	per ton	£164	£6 inc.
g ,, Rod	per ton	£154	£6 inc.
d ,, (Electrolytic) Bars	per ton	£141	£4 inc.
d ,, ,, Sheets	per ton	£159	£6 inc.
d ,, ,, Rods	per ton	£148	£6 inc.
d ,, ,, H.C. Wire	per lb.	1/5⅝	⅜d. inc.
f Ebonite Rod	per lb.	8/-	..
f ,, Sheet	per lb.	2/6	..
n German Silver Wire	per lb.	2/2	..
h Gutta-percha, fine	per lb.	6/10	..
h India-rubber, Para fine	per lb.	9/11½	1½d. dec.
i Iron Pig (Cleveland warrants)	per ton	95/-	..
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£82	..
g Lead, English Pig	per ton	£35 10	5/- inc.
g Mercury	per bot.	£16 12 6 to £16 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	per lb.	3/6 to 6/-	..
e ,, ,, ,, large	per lb.	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/8½	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	per ton	£205 to £206	£1 to £2 inc.
n ,, Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

Canadian General Electric Co.—The accounts for 1915 show a profit of $1,219,513, and after deducting interest and $416,222 for depreciation, there remained a net profit of $764,378. Dividends of 7 per cent. have been paid on both the preference and ordinary shares, leaving a surplus of $66,356, increasing the undivided profit brought down to $1,007,119, out of which $300,000 goes to reserve, raising that fund to $3,000,000, and $707,119 remains to be carried over. —*Financial Times.*

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List:—

Barcelona Traction, Light & Power Co., Ltd.—London scrip, fully paid, for £436,700 7 per cent. 50-year prior lien "A" bonds.

British Coalite Co., Ltd.—A financial daily states that the sale of the company's land at Barking has now been completed, and that out of the price received the first mortgage debentures are being paid off.

American Telephone and Telegraph Co.—The net earnings for 1915 were $41,117,487, an increase of $559,510. The interest charges were $6,498,849, and dividends at the regular rate of 8 per cent. per annum, $29,100,591. Of the resulting balance there was carried to reserves $2,500,000 and to surplus $3,018,046. The indebtedness of the company was reduced during the year by $50,963,560.

Direct United States Cable Co., Ltd.—The accounts for the year ended at March, 1916, show that the reserve fund account balance is £487,705, an increase of £10,719. A fourth and final dividend of 2s. per share (less tax) is announced, making a total of 4 per cent. for the year. Annual meeting: May 2nd.

Calcutta Electric Supply Corporation, Ltd.—The directors recommend a final dividend on the ordinary shares at the rate of 11 per cent. per annum for the half-year ended December, 1915, making, with the interim dividend, 9 per cent. for the year. £52,000 is placed to the credit of the depreciation and renewals fund, and £10,000 to reserve, the same as in the previous year.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MARCH, 1916.

The returns of electrical exports and imports for the month of March show increased values in nearly all sections of the table.

The exports reached the respectable total of £432,396, as compared with £396 483 in February; the imports were valued at £196,251, as against £182,222 in the previous month, while the re-exports, at £17,383, were also considerably in advance of the February figures. Generally speaking, all the sections of the exports, except machinery exports, were at a higher level than in the previous month, the most noteworthy figures being, however, for cable exports, which were valued at £111,031 for the month, an exceptionally high value.

Telegraphic and telephonic exports were also considerably in advance of the February figures.

Electrical machinery imports remained practically stationary and cable imports declined, while telegraphic, telephonic and glow lamp imports (from Holland) advanced considerably in value, as compared with February.

Our best customer during the month was India, followed by France, while, as usual, Australian purchases reached a considerable value.

The total value of electrical material received from the United States during the month showed an advance on the previous month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	1,209	5,133	40	229	...	1,923	13,269	263	60	1,435	...	6,974	30,534
German West Africa	...	50	...	...	...	...	...	...	...	...	...	...	50
Netherlands, Java and Dutch Indies ...	162	11,773	1,231	30	181	...	3,449	159	197	8	2,673	11,622	31,485
Belgian Congo	...	60	...	...	...	...	21	...	...	...	120	...	201
France	2,423	111	708	959	121	220	6,902	10,227	127	17	10,590	8,505	40,910
Portugal	170	1,466	...	60	...	267	2,001	15	...	66	710	1,518	6,273
Spain, Canary Isles and Spanish N. Africa...	362	...	207	...	...	760	1,723	55	86	10	56	62	3,121
Switzerland, Italy and Austria-Hungary ...	1,677	123	528	...	...	685	2,604	193	...	48	60	2,651	8,569
Greece, Roumania, Turkey and Bulgaria ...	...	...	...	...	1,500	...	35	...	...	...	...	...	1,535
Channel Isles, Gibraltar, Malta and Cyprus...	90	6,900	49	56	...	...	108	...	120	...	231	499	8,053
U.S.A., Philippines and Cuba	397	...	28	100	...	...	2,256	...	...	...	...	261	3,295
Canada and Newfoundland	198	14	108	204	...	79	1,393	...	407	...	...	24,902	27,305
British West Indies and British Guiana ...	33	169	35	76	...	...	211	...	...	...	...	46	570
Mexico and Central America	...	64	8	...	...	...	22	...	...	...	11	66	171
Peru and Uruguay	43	313	...	19	...	...	381	...	151	...	63	...	970
Chile	135	80	65	71	...	117	527	1,216	163	412	50	730	3,266
Brazil	201	456	278	251	...	65	1,156	16	597	10	...	25	3,052
Argentina	1,148	8,195	286	686	...	602	5,142	378	751	86	3,611	771	21,656
Colombia, Venezuela, Ecuador and Bolivia...	...	284	...	...	...	...	140	...	...	...	90	...	514
Egypt, Tunis and Morocco	67	1,253	3	12	...	...	424	115	659	158	71	594	3,356
British West Africa	33	303	2	112	...	47	172	...	132	36	97	1,025	1,959
Rhodesia, O.R.C. and Transvaal	1,148	8,473	339	1,434	...	625	3,863	333	354	17	340	383	17,309
Cape of Good Hope	813	4,583	146	527	100	1,350	1,338	5	1,540	...	1,938	61	12,431
Natal	23	5,166	343	103	30	42	3,444	126	814	...	253	...	10,344
Zanzibar, Brit. E. Africa, Mauritius & Aden	202	321	3	353	...	32	699	16	66	...	52	93	1,865
Azores, Madeira and Portuguese Africa ...	3	60	38	150	...	...	127	...	...	...	...	55	433
French African Colonies and Madagascar ...	...	...	...	...	...	...	66	...	...	...	...	...	66
Persia	...	158	116	62	...	...	606	...	...	...	175	...	1,117
China and Siam	291	952	438	426	61	1,326	1,243	...	1,455	51	434	117	6,794
Japan and Korea	403	...	...	64	95	1,358	1,830	10	441	...	...	1,798	5,999
India	4,469	16,654	2,627	3,659	108	1,388	15,795	1,493	4,029	315	3,285	1,999	55,621
Ceylon	184	24	50	180	...	123	316	...	26	...	15	...	918
Straits Settlements, Fed. Malay States and Sarawak	707	1,637	110	325	...	70	1,100	150	212	91	245	384	5,061
Hong Kong	496	22	...	...	...	563	248	251	...	33	115	64	1,792
West Australia	229	1,608	154	985	...	138	2,124	...	75	2	13,099	11	18,425
South Australia	70	...	32	30	...	11	63	...	290	...	...	52	548
Victoria	1,215	18,390	670	957	133	1,310	2,982	2,489	583	20	4	2,072	30,825
New South Wales	1,161	7,362	1,038	2,013	324	266	5,880	167	946	256	7,691	26	27,125
Queensland	326	875	...	13	...	45	1,528	28	1,888	74	3,305	...	8,082
Tasmania	...	...	76	47	21	...	90	...	...	...	...	...	234
New Zealand and Fiji Islands	1,056	8,002	546	1,194	42	879	3,372	5,452	3,312	89	5,999	519	30,462
Total, £	21,174	111,034	10,575	15,387	2,716	14,091	88,250	23,156	19,511	3,234	55,383	67,885	432,396

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	50	...	...	669	77	...	4,696	595	110	...	4,127	10,324
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	41	125	21,648	1,798	...	100	...	333	...	197	24,242
Belgium	...	...	...	...	...	...	...	...	...	...	...	...
France	350	2,890	...	94	32	1,245	283	...	5,214	3,269	452	13,829
Switzerland	1,587	...	156	138	20	1,219	1,157	918	196	745	50	6,186
Italy	...	5,668	...	...	...	18	822	108	...	...	90	6,706
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	8,517	3,699	1,562	4,264	6,106	506	11,503	62,736	5,006	8,457	20,579	132,935
Total, £	10,504	12,298	1,843	26,813	8,033	2,988	18,561	64,357	10,859	12,471	25,495	194,222

Additional imports.—Spain, carbons, £943; Japan, glow lamps, £390; lamp parts, £466; Channel Islands, machinery, £15; Canada, electrical goods, £140; lamp parts, £75.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above.... ...	2,341	2,104	...	2,899	...	1,034	2,666	...	32	310	5,997	17,383

Total Exports: £432,396 Total Re-Exports: £17,383 Total Imports: £196,251

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

SOME LEGAL HINTS TO THOSE WHO SELL MACHINERY.

[FROM A LEGAL CONTRIBUTOR.]

ALTHOUGH a very considerable proportion of judicial time is occupied with the decision of cases relating to the sale and purchase of machinery, but few reports of such trials appear in the papers. They are either too technical for the average reporter to record with accuracy, or too complicated or dull for the reader of the newspaper. An action for breach of promise affords better "copy" than an action for breach of warranty on the sale of a "booster"!

In these circumstances a few hints to the vendors of machinery, derived from experience in cases which have either actually been decided or have at least got into the lawyers' hands, may be found useful to engineers.

In many of the disputes arising out of the sale of machinery which occur in practice, the first question at issue is this: What was the contract between the parties?

In his natural anxiety to secure the business, the manufacturer is sometimes careless about the guarantees to which he stands committed. On the other hand, to obtain machinery of which he is in urgent need for the fulfilment of an important order, the purchaser sometimes closes a bargain without making his requirements absolutely plain, and without securing specific guarantees that the machine in question will do what is demanded of it.

Selling a complicated piece of machinery is not like selling a top hat. In the latter case the customer comes to the premises of the vendor, pays his money, buys the goods "on the view" and takes delivery on the spot. No question of guaranty arises. The customer does not—cannot—come back in six months' time and say: "This hat will not do the work required of it," and then bring suit for damages.

Where, on the other hand, machinery is sold a number of considerations may arise. It has to correspond with a long and complicated specification. It is generally guaranteed to do certain work under certain conditions which must be precisely explained. Let there be any departure from those conditions and the machinery will not do its work. Finally, it may have to work in conjunction with machinery supplied by another manufacturer or by the purchaser himself. It is of the utmost importance that the rights and liabilities of the parties in relation to all these matters shall be borne in mind *when the contract is framed*.

It often appears to be thought unnecessary to draw up a special contract when the parties are negotiating about a mere piece of machinery. A conversation, or a ring-up on the 'phone—confirmed (or not) by a brief letter—is sometimes considered sufficient.

Again, when a dispute arises, it frequently happens that the lawyers have to determine the real contract from (*a*) the evidence given of conversations at various interviews; (*b*) telephone conversations; (*c*) telegrams; and (*d*) letters. Small wonder, if the component parts of the contract are thus disseminated, that disputes arise as to what those terms really are.

The first principle, then, is to put the contract into writing. *Vox emissa volat sed res scripta manet* is a maxim which should be written up in every office.

In cases where an arrangement is made orally, it should always be confirmed by letter, unless it is considered that to so confirm it would be regarded with suspicion by the purchaser. In that event a memorandum of the transaction should be made by the manufacturer in his own handwriting in his own diary on the same day, and when the facts are fresh in his memory. In 99 cases out of 100 he may never have to refer to the entry again; but if a dispute occurs, and he has to state his recollection of what took place at the interview, he can refresh his memory by looking up the entry.

These are more or less general observations appertaining to all contracts; but there are certain specific things to be remembered when selling machinery. Assume the agreement is to be in writing, what should that writing contain?

In the normal case there will be an inquiry from the customer for a particular machine capable of doing so much work. The manufacturer replies sending a specification in which the machine is described. He also makes a tender to supply it at a particular price. It is in the conditions annexed to the tender that he should take particular care to make plain the circumstances in which the machine which he supplies will carry out his guarantees.

The following points should be made in the general conditions to accompany a specification and tender:—

1. *Continuous Working.*—Assuming the machinery is guaranteed for a certain period, the question whether it is to work continuously should be borne in mind. A machine guaranteed for six months' working continuously might be guaranteed for 12 months if only working by day. Again, continuous working may be an essential requirement—as, for instance, in the case of a condenser for a sugar refinery—and the manufacturer must be careful not to make himself responsible for continuous working unless he knows the machine will stand it.

2. *Indirect or Consequential Damage.*—It is sometimes prudent to say in the conditions: "The manufacturer undertakes no liability for indirect or consequential damage of any nature or due to any cause." This has effect, at any rate, to compel the purchaser to reveal the purposes to which the machine is to be put. But such a disclaimer will not release the manufacturer from the consequences of a breach of warranty. For instance, if an engine be sold as being of 10 H.P., and it turns out to be only 7 H.P., with the result that the purchaser suffers damage, this clause will not relieve the manufacturer.

3. *Machinery of Other Manufacturers.*—A composite machine or piece of apparatus may include the workmanship of other manufacturers. As to this it is well to say: "Any machinery not of our own manufacture included in this tender is sold under the warranty given to us by the makers, and which we are able to enforce, but it is not guaranteed by us in any respect."

4. *Drawings.*—It should be pointed out that drawings, &c., submitted with the tender and contained in illustrated catalogues which may form the basis of the contract are approximate only, and that after acceptance of the tender accurate outline drawings will be supplied.

The foregoing are some general conditions which will be found applicable in most cases where machinery is to be supplied.

Some particular cases remain to be considered. The manufacturer is often asked to furnish something which is to be worked in conjunction with an old machine already installed on the premises of the purchaser. In that case he should be careful to limit his guarantee by saying that what he is selling will do so much "provided the efficiency of the existing plant is as stated." A case occurred a year or two ago where an atmospheric condenser was supplied with a guarantee that it would maintain a constant vacuum of 25 in. to 26 in., with the barometer at 30 in., in the vacuum pans at a sugar factory. When installed, the condenser appeared to be unable to maintain the vacuum. In the course of a long inquiry it was found that while the condenser itself was free from leaks there was immense and abnormal leakage of air into the sugar pans which was quite sufficient to explain the drop in vacuum. In supplying a condenser, therefore, the manufacturer should be careful to point out the conditions under which he guarantees that the vacuum will be maintained.

One or two other instances come into mind. Where a gas engine is supplied and is stated to be of a certain horse-power, care should be taken to specify the quality of the gas which must be used if the full power is to be attained. For example, coke-oven gas and producer gas may vary very considerably in calorific value. In such cases the specification should state that the gas to be used must be able to produce so many B.TH.U. per cb. foot.

As a last example, mention may be made of a specification for refrigerating machinery. Here again, in the nature of things, something that is essential for the proper working of the machine may have to be supplied by the purchaser himself. The writer calls to mind a case in which a carbonic anhydride refrigerating machine was guaranteed to be able to produce a certain number of tons of ice *per diem*. The specification was very complete, but it made no reference to cooling water. There was nothing to show whether that water was to be supplied from the mains, or

whether it was to be circulated from some kind of re-cooling device. This is clearly a matter which should be provided for in the conditions attached to the tender. The purchaser should be told either that the refrigerator will require so much water from the mains (the amount depending to some extent on the season of the year) or that a re-cooling device of a certain capacity must be installed.

But a few examples have been given above to show the necessity of disclaiming responsibility for the vagaries of apparatus supplied by the purchaser. It would, doubtless, be possible to multiply instances in the case of more complicated machines.

THE USE OF CONTINUOUS CURRENT FOR TERMINAL AND TRUNK LINE ELECTRIFICATION.

On March 21st the paper on this subject by Mr. N. W. Storer, which was read before the Institution of Electrical Engineers, was discussed by the Manchester Local Section.

The Chairman (Mr. B. Welbourn) endorsed the plea which the author made for some attempt to be made, before it was too late, to secure the standardisation of voltage and collector systems in this country. It was to be hoped that in connection with railway electrification work they would not have a repetition of what had happened in the electricity supply industry.

Mr. W. A. Barnes, referring to standardisation, pointed out that direct-current traction was competing very strongly with alternating-current traction in the only advantage the latter possessed, namely, high-voltage transmission, and on this account it would not be policy at the present time to standardise 1,200 or even 2,400 volts. Another point against standardisation at the present time was that such a course would tend to stop progress. The question of the location of the third rail had been brought before a meeting of railway engineers as long ago as 1903, when it was decided that the most advantageous position for the third rail was such that the contact surface be 3 in. above the track rail, and that the horizontal distance between the centre of the track and the centre of the third rail be 3 ft. 11½ in. This was adopted for an overrunning shoe, and it was thought that 600 volts would not be exceeded for direct-current electric traction. The above recommendation had been adopted by railway companies who electrified since 1903, but during the past two years the direct-current traction motor had been greatly improved, so much so that the 1,200-volt motor was probably more reliable than the 600-volt motor of ten years ago. The 600-volt third rail was not sufficiently well protected to be used at 1,200 volts, and on the Manchester-Bury section of the L. & Y. Railway, where 1,200 volts was in operation, this had led to the adoption of the side-contact rail adequately protected along its entire length, thus departing from the earlier standard. The gear required to operate at various voltages would have to be accommodated inside the car, and together with the equipment for regenerative control and the apparatus for changing the position of the shoe would seriously limit the passenger-carrying capacity of the car, and would cost more for maintenance and running charges. It was probable that in trunk line electrification any one railway company would adhere to one system, and only inter-running trains would be affected; he suggested that such trains be ordinary stock worked by electric locomotives which would be changed at the junction of two systems, and where through coaches were involved, trailer coaches should be used in conjunction with motor coaches in the usual way. The choice of motors depended on the relative importance of efficiency of working and efficiency of service.

Mr. Ferguson considered that the first step should be to standardise line voltage. The inter-running of trains over systems employing different voltages had been shown to require a relatively large number of switches; in maintaining equipments of this kind, however, it was well to remember that so far as the main control was concerned it was only necessary to deal with a number of similar contactors or reverse-type switches, all of which were fairly well-known pieces of apparatus, hence the maintenance was only increased in proportion to the number of similar pieces. The case of auxiliaries for high voltages and various voltages was very different, necessitating, as a rule, new types of apparatus more or less exploited and undeveloped. In the case of equipments having to run at comparatively high speed on the suburban parts of a railway, say, 2 to 4 miles between stops, and also on city lines with only half-mile stops, the field control was the proper thing, but required extra switches and extra cables, involving additional capital cost and maintenance, and there were cases where it would be advisable to put the money and material into building a large motor having a non-saturated field.

Dr. Wm. Cramp said that emphasis was laid upon what were called saturated and non-saturated fields, and no indication was given as to the point at which distinction between saturated and non-saturated was drawn. A case had been made out against the rating of railway motors on the one-hour basis; it was to be hoped that the Institution of Electrical Engineers or the Engineering Standards Committee would go into this question with the object of sanctioning a more rational basis for specifications. Such a basis had already been suggested by Dr. Pohl. The second part of the paper was a most eloquent plea for standardisation, and showed into what confusion railway equipment would be thrown if some control was not quickly exercised. The adoption of the single-phase system would obviate many of the difficulties mentioned; in fact, the paper might be turned into a demand for the single-phase system, so long as there was no co-ordination between the railway companies as regarded voltage. In the single-phase system only frequency needed to be standardised, and that only within certain limits, which should not be difficult to decide upon. Series-parallel operation of transformer or motor windings would meet all other variations. It was ridiculous to construct trains on such short lengths of line as existed in this country, with so much complicated apparatus to change from one railway company's system to another. If it were necessary to have voltages varying over the range suggested by the paper, the continuous-current system should not be adopted at all. The only solution seemed to be some form of control which would prevent a company adopting a system different from that adopted by another company, without showing good cause for the difference, and the method to be adopted to secure interchangeability.

Prof. E. W. Marchant said that one of the main advantages of series-parallel control lay in the greater efficiency on starting. The maximum possible efficiency in starting with series-parallel control and two motors was 67 per cent., whereas, starting with ordinary rheostatic control, the loss was 50 per cent. Taking the ordinary limit accepted in this country of from 150 to 200 amperes from the trolley, it was clear that very high voltage would be required on the trolley wire in order to obtain the power required to drive a railway train. Regarding the question of the D.C. voltage possible on a dynamo or motor, Mr. Catterson-Smith had experimented some four or five years ago, using a motor designed to work under compressed air at 200 lb. per square inch. The armature was designed for 3,000 volts, and he succeeded in getting an output of about 3 kw. from the machine, which was 2-pole and had a commutator only 4 in. in diameter. The design of the bearings was a most difficult matter, on account of the air pressure on one side, and the mechanical difficulties involved were too serious to warrant much hope of final success.

Mr. A. P. M. Fleming expected a great deal of trouble with high voltages, particularly in view of the extremely arduous conditions under which railway services operated in regard to moisture, dust, and oil.

Mr. C. H. Wordingham most strongly deprecated the nationalisation of railways; every country which had nationalised its railways had done so to its own detriment. Once the feeling of competition was removed, bad as railways might be in certain respects at present, they could be infinitely worse if nationalised, and it might be said without doubt that a Government department was not in a good position to conduct trading operations successfully or with advantage to the public. It was essential to confine standardisation chiefly to questions of interchangeability, and not to attempt to standardise design. By adopting a rigid standardisation, mechanical or electrical, there was a grave danger of stifling progress.

Mr. J. S. Peck said that whilst it was not possible to standardise completely, as by so doing progress might be seriously hampered, if certain provisional standards were adopted—say, 600, 1,200, 1,800, and 2,400 volts—it would prevent one railway company from adopting, say, 1,200 volts and an adjacent company 1,300 volts, 1,500, or other odd voltage which seemed at the moment to possess some special advantage. Unless some effort was made to standardise very soon, there would be the same multiplicity of voltages that existed in the States, where they had 500, 600, 750, 1,200, 1,500, 2,400, 3,000, and 5,000 volts. Mr. Barnes's suggestion of using electric locomotives operating only on their own systems seemed a very important solution of the problem. If the railways were ever amalgamated, one of the first things would be to adopt a standard voltage, which would necessitate scrapping a large amount of expensive equipment. Why should not standard voltages be adopted, as would be the case if all the railways in this country were under one management? The question of the shunt motor being more sensitive to fluctuations in line voltage was explained by the self-induction of the shunt motor field, due to many turns of fine wire, being much, very much, higher than that of the series motor with a few turns of large wire. If the line voltage went off and was suddenly thrown on again, or whenever there were large fluctuations in line voltage, there was a tendency for very large rushes of current to occur. The field of the shunt motor was sluggish in building up, and the very heavy armature current distorted the field and was apt to produce flashing. The maximum current which could be collected from a trolley wire was dependent a good deal upon the type of trolley and size of wire, but 250 to 200 amperes could be collected without much difficulty, even at high speeds. An advertisement some time ago showed a double pantograph trolley which would collect 4,000 amperes at 40 m.p.h. Compressed air was a very excellent insulator, and it had been proposed in connection with transformers in order to stop static discharge. The author

had written to Mr. Peck to say that the only difficulties they had experienced so far with the 5,000-volt control equipment were due to earths on the resistance, due to running through slush and snow; that, however, was very easily remedied.

ELECTRIC POWER IN SLATE QUARRIES.

By G. K. PATON, A.M.I.E.E.

(*Abstract of paper read before the* Liverpool Engineering Society, *April 12th*, 1916.)

It is only within the last ten years that electric power has been introduced to any extent in the slate quarries of North Wales, some of which have been in active operation for a century or more. Under the terms of the North Wales Electric Power Act of 1904, the company is authorised to supply power in bulk to power consumers with an equivalent amount for lighting purposes.

The transmission lines of the Power Co. now extend to the principal quarrying districts in an area of nearly 400 square miles, supplying slate and granite quarries, aluminium works, and also the New Carnarvon transmitting station of Marconi's Wireless Telegraph Co., Ltd.

The generating station is situated at Cwm Dyli, near Penygwryd, in the Gwynant Valley.* Water power is the prime mover at an effective head of 1,150 ft.

Four Pelton wheels, each of 1,600 B.H.P., are installed, coupled to 1,500-K.V.A. alternators with direct-coupled exciters, generating 3-phase current at 10,000 volts 50 periods when running at a speed of 500 revolutions per minute.

Power is transmitted to the various consumers by overhead transmission lines, and each consumer has one or more substations, equipped with two 3-phase oil-insulated transformers, varying in size from 100 to 750 K.V.A. capacity according to requirements.

The neutral of the E.H.T. system is earthed at the power station, and it is advisable that the neutral on the L.T. side should also be earthed. The earthing system in a slate quarry is important on account of the slate debris, which gives a poor "earth"; an earth wire should be run beyond the debris to obtain satisfactory results.

In slate mines bitumen-insulated armoured cables are the most suitable for voltages up to 550 volts. The moisture underground causes rubber to perish quickly. All cables should be armoured, the armouring being used as an earth conductor.

Overhead lines have to cross innumerable rails and footpaths, and it is often necessary to guard the lines throughout their whole length; owing to the extreme weather conditions, guarding with earthed cradles is impossible.

A simple and effective design for a 1,000-volt single circuit line is given in fig. 1, which is self-explanatory. Double circuit lines with channel arms are arranged with two insulators per conductor, to one of which the line wire is bound, and to the other is attached the anchor wires. An earth bar is fixed as an additional protection to earth the live wire effectively should it fall. Both designs are based on the fact that the insulator is the weak point of a line, and should it fail the wire may fuse or break at this point. The second insulator and anchor wires then prevent the conductor from falling.

A continuous earth wire should be run throughout, and all ironwork, motor frames, switch ironwork, and the neutral point of the secondary, efficiently connected thereto.

In Blaenau Festiniog the workings are all underground, and consequently the slate blocks and most of the debris require to be hauled to the surface, electric power being used in the larger quarries. Power is required in operating inclines, slate saw sheds, air-compressors for rock drills, ventilating, and also for pumping. In the Nantlle district the quarries are of the open pit type. Hoisting in these quarries is done by aerial suspension cableways and inclined hoists.

Slate saw sheds should be erected as near as possible to the part of the quarry from which the blocks are obtained. Advantage should be taken of the electrical supply to install units of 15 to 20 B.H.P., driving 12 to 15 saw tables, instead of the older method of concentrating all the saw tables in one large shed. When conversion is made to electric drive in these large sheds it is better to sub-divide into groups of 12 to 15 tables, each group being driven by a separate motor.

A convenient arrangement, recently laid down in Penrhyn quarry, is a shed 162 ft. by 58 ft., containing 12 saw tables, each driven by a belt from a main shaft, 4 in. diameter at the centre and tapering to 3 in. at the extreme ends, driven from the centre by means of a squirrel-cage, 3-phase induction motor of 20 B.H.P., coupled to a worm gear with a speed ratio of 960-45 R.P.M., the secondary shaft being direct coupled to the main shaft. An outline of this type of motor and worm gear is given in fig. 2. The slate tables are arranged six on each side of the motor equipment.

So far, artificial lighting has not been a success in saw sheds, owing to the habit of quarrymen to work only in daylight. In winter the working hours are thus reduced to eight hours per diem, but even then there are periods when artificial lighting is necessary indoors; the cost is so little that it is surprising that more use has not been made of electric lighting in sheds—to the author's knowledge, only one quarry has installed it.

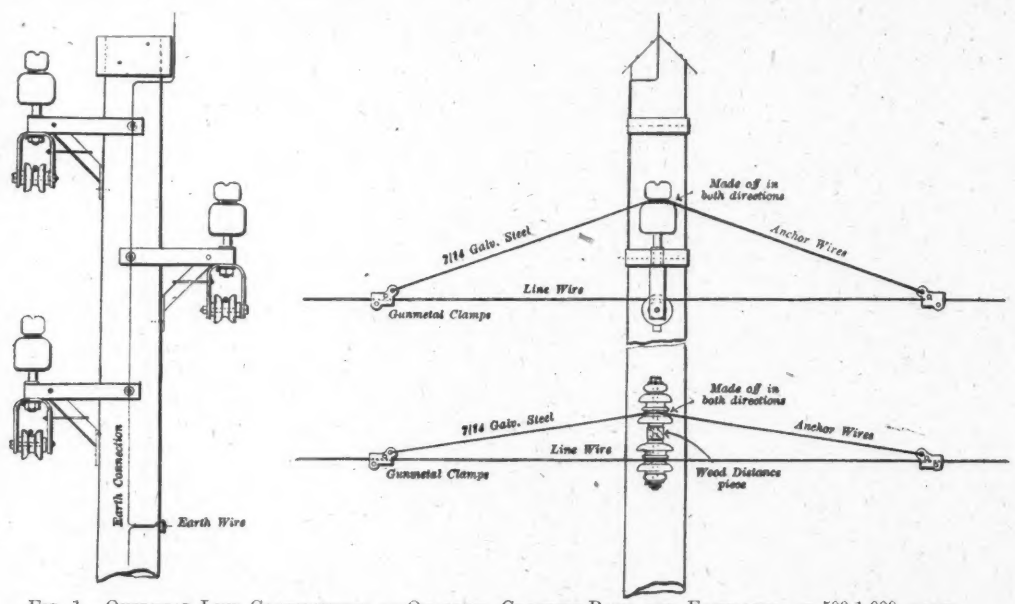


Fig. 1.—Overhead Line Construction in Quarries, Crossing Rails and Footpaths, at 500-1,000 volts.

In changing over an existing shed to electric drive, a belt drive is employed from the secondary shaft on the motor, running at about 240 R.P.M., to the main shaft at 45 or 60 R P.M. Slate dust causes considerable wear on paper or hide pinions, and it is nearly impossible to prevent dust getting about, as it is carried by the belt, even when the motor is fixed in a different compartment. A helical cut gear gives good results .

It is always preferable to use a belt drive, but when a speed reduction to 45-60 revolutions is required, this is only possible by means of a slow-speed motor. The "Cascade" motor is suitable for this purpose, a 15-B.H.P. motor running at 320 R.P.M., synchronous speed 333 R.P.M. The pulley ratio is about 7 to 1, and consequently the motor pulley is small in diameter.

From the Power Co.'s point of view, it is better to use high-speed motors, giving a higher power factor at half to three-quarter load, which is about the average over the running periods of the day.

The cost of power in slate saw sheds may be taken at 5d. to 7d. per ton of output, depending on the quality of rock, hard or soft, at one penny per unit. The running load factor varies from 45 per cent. to 55 per cent. over 9½ working hours per diem. The actual power required per table (8 ft. by 4 ft.) is on an average 1.1 KW. From tests taken, the actual cutting

* A full description of the plant has appeared in the Electrical Review.

power per table is approximately 1 H.P., giving an overall efficiency of 68 per cent.

Where the quarries are of the open pit type, the slate blocks and debris require to be lifted out of the pit; aerial suspension cableways and inclined ropeway hoists are used for this work.

In the case of the inclined ropeway hoists, two heaving ropes are employed on one drum, one paying out as the other is pulled in, and the wagon and rope weight is balanced during most of the travel. In practice, however, it is found that the empty wagon descending is actually landed before the full wagon reaches the top of the mast at the upper landing stage. Consequently, the power required at the end of the lift is that required for the gross weight of wagon and load. The single hoist, with two main ropes, lifts a gross weight of 50 to 60 cwt., one empty wagon descending while the other load is lifted. The double hoist is arranged with four main ropes and is used to lift one or two full loads at a time, as may be required. The single hoist is driven by a 70-B.H.P. motor and the double hoist by a 150-B.H.P. motor.

The total net weight lifted with 1,135 loads during tests was 2,380 tons, and the corresponding units registered were 1,140 units, which gives per net ton lifted 0.48 unit and approximately 1 unit per journey or load.

The overall efficiency is 75 per cent. with unbalanced load, and about 85 per cent. with the wagon weight balanced, a result which may well be considered satisfactory. The time taken for each complete operation is about 1¾ minutes, so that it is not impossible to do one journey every 2½ minutes, equal to about 200 loads per day, or, approximately, 400 tons net. Under these conditions, the motor would take 200 units per diem, although actually about 100 units per diem would be a good average under normal conditions.

100 units per diem represents a load factor of 18.5 per cent. over nine working hours per diem, but taken over longer periods when other conditions, weather, &c., interfere with outdoor work, the load factor averages from 12 to 15 per cent. only. In other words, to the Power Co., a winding motor taking a maximum demand of 60 KW. intermittently, consumes in a day from 60 to 100 units, representing from 0.9 to 1.43 units per H.P. per diem, which at 1d. per unit brings in a revenue of from 5s. to 8s. 4d. per diem.

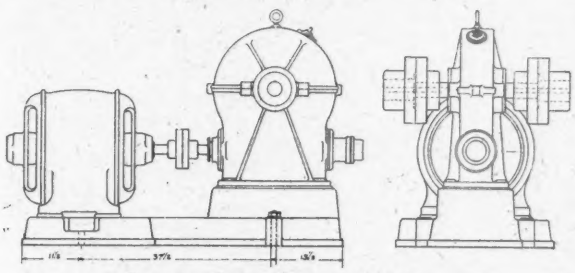


FIG. 2.—WORM GEAR AND MOTOR.

In the case of aerial suspension cableways, two winding drums, one for heaving rope, and the other for the endless travelling rope, are employed. The drums are independent of each other, and each drum has a separate band brake with foot control. The endless rope serves to hold the load carriage in position when hoisting and lowering. For travelling horizontally, the hoisting rope is drawn in and the endless rope is paid out at the same speed, the drum diameters being equal. The load may be hoisted or lowered at any point under the line of cable, and the horizontal motion may be given to the load at any height to which it may be raised. The direct lifting speed is one-third of the rope speed. Compared with the inclined hoist, which has fixed positions for picking up, it will be seen that the aerial cableway can pick up and lower at any point across the main cable.

The following particulars relate to three such cableways in operation at Penrhyn Quarry, with spans of 965, 1,010, and 1,015 ft.:—Gross load, each 60 cwt.; hoisting speed, 300 ft. per min.; travelling speed, 900 ft. per min.

Winding drums, 5 ft. diameter, giving maximum rope speed of 900 ft. per min.

Motor, 70 B.H.P. 3-phase, 50-period, 500 volts, 570 R.P.M. Slip ring, reversing, enclosed ventilated type, with extended shaft and third bearing.

Controller, Westinghouse F. 12A drum-type reversing controller, with 11 steps forward and reverse, arc shields, five-minute rated open-type, cast-grid resistance.

Switch panel, totally enclosed, oil-break automatic circuit-breaker with no-volt and overload releases, fitted with adjustable time lags.

As the driver is not in full view of the landing points in the bottom of the quarry, an electric signalling system is used, with luminous signal receiver fitted in the driver's room. The signals are given from a signal box in full view of the workings under the cableway.

The main cable suspended across a span of 1,000 ft. forms a catenary, and the power required in traversing varies according to the direction and slope of the cable.

Over a definite period 423 complete journeys were made (in and out), when the net tonnage lifted amounted to 887 tons. During this period the energy used amounted to 650 units, equal to 0.733 unit per ton, or 1.54 units per load of 42 cwt.

In another cableway the tonnage noted in 255 journeys was 574 tons, when the energy consumed amounted to 516 units, giving 0.9 unit per ton lifted, or 1.89 units per load of 42 cwt. net. These figures include journeys made with empty wagons.

The time of a complete cycle of operations is six minutes, equal to 10 journeys per hour, as a maximum. In a 10-hour working day this would give at most 100 journeys, or about 200 tons per diem, which probably has not yet been attained in ordinary working.

Taking 200 tons per diem as a maximum, the consumption of energy at an average of .8 unit per ton would be 160 units.

The average load requires a maximum power of 60 KW. or 70 B.H.P., which gives an average of 2.28 units per H.P. per diem. Over a longer period the average would amount to only about 50 units per diem, equal to only .715 unit per H.P. per diem. This is equivalent to a load factor of, say, 9 per cent. to a possible maximum of 28 per cent. over a 10-hour day, and under normal working conditions 10 to 15 per cent. would be a fair average.

The costs and tonnage handled by each type of haulage are given below:—

Type of cableway.	Cost of equipment.	Tonnage per diem. Max.	Tonnage per diem. Aver.	KW.	Units per ton.	Load factor. Max.	Load factor. Aver.	Overall efficiency.
Single incline hoist* ...	£600	400	130–200	60	0·48	85%	12–18%	76%
Aerial suspension cableway† ...	£900	200	50–100	60	·733–·9	28%	10–15%	65–70%

* Diagonal lift, 300 ft. Travel 400 ft.
† Vertical lift, 165 ft. Travel 900 ft.

The approximate cost given in column 2 includes complete electrical equipment, ropes, masts, buildings, foundations and anchorages. The electrical equipment of the single hoist and aerial cableway is similar, with 70-B.H.P. motors and controllers.

From the figures given it will be noted that the actual tonnage handled by the inclined hoist is practically double that of the aerial suspension cableway.

Both types are used in Penrhyn Quarry, the cableways spanning the open workings, and landing the wagons on rails on which they are taken under the inclined hoist. The hoist then lifts the wagons another 300 ft. to the level of the debris tips. One hoist deals comfortably with the tonnage handled by two aerial cableways. In this way, 200 to 300 tons of debris per diem are removed from one part of the quarry workings, lifted a height of 400 to 500 ft. and a distance of over 1,500 ft., at a power cost of about 1½d. per ton.

Rock drilling in slate quarries is usually carried out by compressed air operating hammer drills; there is a big field for electric drills if they can be proved satisfactory.

A typical installation consists of an Ingersoll-Rand two-stage belt-driven compressor, driven by a 150-B.H.P. 3-phase, 50-period, 500-volt, 575-R.P.M., slip-ring, 3-bearing induction motor. Regulation of the air pressure is maintained within any desired range, usually between 80 and 100 lb., by a mechanical unloader, which operates by entirely closing the air intake, the power on the motor dropping immediately the intake pipe closes.

If a compressor is too large for its work, it is a good method to have a smaller pulley fitted to the motor and run the compressor at a reduced speed. This is done in one large quarry with good results, three different sizes of pulleys being used according to the number of drills in use.

The power consumption is dependent upon the number of drills in use, and the number of hours the plant is working. On an average, the daily load factor over a 10-hour working day is from 50 to 60 per cent., equal to 4 or 5 units per H.P. per diem.

A considerable amount of pumping is required in some quarries, and turbine pumps direct coupled to high-speed electric motors are in use. The sizes in use vary from 15 to 200 B.H.P., with a discharge up to 1,200 gallons per minute against a head up to 400 ft. The larger pumps are usually controlled from switchgear near the motor, but with smaller pumps it is possible to control them from a higher level. This is of great benefit in open quarries, as at night-time it is unnecessary for the attendant to go down to the pump, which is a more or less risky proceeding even in daytime.

It is sometimes necessary for pumping to be continued night and day, it is therefore necessary for power to be available at all times, and a bulk supply is of great benefit.

The winding or haulage load accounts for 58 per cent. of the total demand, with a poor load factor.

Air compressors and slate sawing machinery tend to balance matters with their increased load factor, but the resulting demand on the Power Co.'s system is not ideal.

The plant diversity factor equals 2. In other words, a demand of 250 KW. on the power plant will supply a quarry plant totalling 500 KW. Totalling the individual quarry H.P. connected against the actual maximum demand on the power station gives a diversity factor of about 3.

While the present state of the slate trade may not warrant further capital expenditure, and each particular quarry must be considered by itself, the actual working costs with modern machinery are so small compared with the additional revenue from increased output and reduced working costs, that no quarry manager should be content to work under the conditions which prevailed in the past.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AUSTRALIA.—By a Proclamation, dated December 15th last, the importation or exportation is prohibited of any goods packed in a bag or sack when the combined weight exceeds 200 lb.

SWEDEN.—The exportation of antimony, unmanufactured platinum, and platinum wares other than those with precious stones or pearls inset, has been prohibited recently.

ITALY.—By a Decree dated February 17th certain Customs privileges are granted in favour of new industries. For a period of five years from March 1st exemption from Customs and Octroi duties will be granted in respect of machinery and building materials destined (1) for the establishment of factories for producing articles not already manufactured in Italy, or the products of new industrial processes; and (2) for factories existing in the Kingdom, in order to enable them to undertake industrial processes not hitherto applied, or to obtain products supplementing those already manufactured in such establishments. Regulations for the application of these privileges are to be laid down by Decree.

GUATEMALA.—A Decree, dated September 9th, 1915, provides that, as from October 1st, 1915, Guatemalan Consular Officers were to collect the undermentioned fees:—

For the legalisation of invoices, 2 per cent. of the value of the merchandise.

	American gold.
For the legalisation of ships' manifests	10 dollars.
For the "visa" of each bill of lading in quadruplicate	1 dollar.
For each additional copy	1 dollar.
For the "visa" of bills of health	2 dollars.
For the legalisation of signatures to documents to be used in the Republic	3 dollars.

RUSSIA.—Information has been received at the Board of Trade to the effect that the competent Russian authorities have decided that the differential rates of duty which are leviable on goods falling under certain sections of the Russian Customs Tariff, when imported over the Western land frontier, are not to be levied on such goods when they are imported *viâ* the Swedish-Finnish land frontier.

[Note.—The differential duties referred to consist of the rates for goods imported by sea, increased by 20 per cent., and are leviable under Sections 140-2, 149-61, &c., of the Russian Tariff, which has been published as a Parliamentary Return (Cd. 7,854, price 7d., ex postage). The sections in question relate, *inter alia*, to certain iron and steel manufactures, and wire and wire manufactures (including electrical cable of all kinds).]

SWEDEN.—The exportation of molybdenite has been prohibited as from March 17th, and of calcium carbide and nitrogen carbide (*calcium cyanamide*) as from April 1st.

NETHERLANDS.—The exportation of asbestos has been prohibited as from March 27th, and of zinc ore and zinc oxide as from April 1st.

SOUTHERN RHODESIA.—The following Customs decision has recently been announced:—

Washing machines driven by electrical power are dutiable under No. 193 of the Tariff at the general rate of 20 per cent. *ad val.*, the rebate allowed on goods manufactured in the United Kingdom or British Possessions (whether reciprocating or not) being 9 per cent. *ad val.*

NEW ZEALAND.—A revised decision has recently been issued by the Customs Department regarding the tariff classification of accessories for motor vehicles, cycles, and motor cycles. Certain articles, among which are included electric batteries and switchboards, will only when accompanying the motor vehicle, &c., to which they belong, be classed as parts of same. When imported separately they will be classed under appropriate tariff headings.

BRITISH SOLOMON ISLANDS.—A Proclamation has been issued under the "Solomons (Customs) Regulations, 1907," embodying new schedules of goods dutiable and free, respectively, on importation, with effect from January 19th. Among the articles exempt from duty are machinery (including electrical) and component parts thereof which the High Commissioner may from time to time specify. The schedule of goods dutiable mentions fuse, the duty on which is 10 per cent. *ad val.*, and this rate is also payable on all goods not specifically tariffed or not included in the list of exempted articles.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

5,237. "Automatically-controlled electric heater for water, &c." Sir C. S. Forbes. April 10th.
5,240. "Sparking plugs." A. E. Lamkin. April 10th.
5,257. "Sparking plugs for internal-combustion engines." A. B. Back. April 11th.
5,259. "Motor-driven vehicles whereof the motor may be utilised for driving the vehicle or dynamo carried thereon." J. L. Gordon. April 11th.
5,252. "Electrical alternating-current machines." J. L. Brown. April 11th.
5,279. "Apparatus for cutting wires or cables under water." G. W. Sutton. April 11th.
5,280. "Gas alarm and telegraph." J. M. Meadows. April 11th.
5,289. "Electric cable-laying machine." E. C. Blackstone, E. Carter, F. Carter and R. E. Watts. April 11th.
5,293. "Dynamo-electric machines." D. Suchostawer. April 11th.
5,300. "Electric arc lamps." T. L. Carbone. April 11th.
5,319. "Sparking plugs." V. Pons. April 11th. (France, May 14th, 1915.)
5,325. "Semi-automatic telephone exchange systems." G. Deakin, L. Polinkowsky & Western Electric Co. April 11th.
5,337. "Electrical aim corrector and teacher." J. M. Charlton. April 12th.
5,341. "Insulators for supporting electricity conductors or appliances." J. W. Astley and British Insulated & Helsby Cables, Ltd. April 12th.
5,343. "Electric lampholders." A. P. Rutherford. April 12th.
5,377. "Dynamo-electric machines." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 12th.
5,391. "Continuous-current generators." Allmanna Svenska Elektriska Aktiebolaget. April 12th. (Sweden, May 5th, 1915.)
5,398. "Insulating compositions for electrical purposes, &c." J. Andersen and E. Soberg. April 12th.
5,422. "Portable military telephones." J. W. Dungey & C. B. Kersting. April 13th.
5,442. "Electro-thermic induction furnaces." C. B. Foley. April 13th.
5,445. "Electrical controlling apparatus." E. C. R. Marks (H. Goldberg). April 13th.
5,458. "Wireless telegraphy and telephony." Soc. Francaise Radio-Electrique. April 13th. (France, December 28th, 1914.)
5,466. "Wireless telegraphy and telephony." Soc. Francaise Radio-Electrique. April 13th. (France, March 1st, 1915.)
5,471. "Wireless telegraphy and telephony." Soc. Francaise Radio-Electrique. April 13th. (France, March 9th, 1915.)
5,497. "Electric wire-cutting device." W. McRostie, A. Willows & F. Willows. April 14th.
5,498. "Shunting device for windings of electro-magnets." W. A. Stevens. April 14th.
5,501. "Field or portable telephones" H. Burge. April 14th.
5,507. "Purifying and alloying iron." British Thomson-Houston Co. (General Electric Co., U.S.A.). April 14th.
5,524. "Arc light electrode with capillary passages." Planiawerke Akt. Ges. fur Kohlenfabrikation. April 14th. (Germany, September 13th, 1915.)
5,526. "Dynamo-electric machines." A. H. Neuland. April 14th.
5,559. "Machines for laying cables and wires underground." W. E. Martin. April 15th
5,567. "Means for concentrating or intensifying light of electric filament lamps." A. G. France. April 15th.
5,568. "Reflectors." A. G. France. April 15th.
5,569. "Electric incandescent lamps." A. G. France. April 15th.
5,570. "Storage batteries." W. A. Crowdus. April 15th. (U.S.A., April 22nd, 1915.)
5,573. "Reflectors and shades of electric lamps, gas lights, &c." A. G. France. April 15th.
5,577. "Electric switch." G. Markt. April 15th.
5,579. "Special service system for machine telephone switching exchanges." F. R. McBerty, L. Polinkowsky & Western Electric Co. April 15th.

PUBLISHED SPECIFICATIONS.

1913.

27,646. Circuit Arrangements for Telephone Systems. Siemens & Halske Akt. Ges. December 1st. (November 30th, 1912.)

1914.

17,175. Process for Electrically Separating Suspended Bodies from Electrically Insulating Fluids, especially Gaseous Fluids. E. Möller. July 20th. (July 22nd, 1913.)
24,537. Electro-magnets. H. Grob. December 23rd.
24,841. Machines for Cutting the Globes of Electric Incandescence Lamps and the like. Allies' Electric Lamp Co. (le Naour). December 31st.

1915.

882. Dynamo-electric Machines and Installations. Soc. Anon. des Etablissements L. Bleriot. January 19th. (February 7th, 1914.)
1,221. Electric Arc-lamp Carbon Ferrules. T. Moore. January 26th.
4,582. Telephone Systems. A. B. Smith. March 24th. (March 25th, 1914.)
4,593. Means for Establishing Positive Electrical Connection between an Aeroplane or the like and its base. H. A. Von Post. March 24th.
4,849. Apparatus for Electrically Detecting Vibrations. F. Gottschalk. March 29th.
4,862. Electric Oscillating Systems. H. R. Rivers-Moore. March 29th. (Addition to 1,649/10.)
4,896. Electric Switches as Applied to Stop Motions on Textile Machinery. P. Sharp. March 30th.
4,953. Sound-magnifying Appliance for Telephonic and Telegraphic Purposes. H. Smith. March 31st. (April 18th, 1914.)
5,240. Joints of Pipes and Couplings applicable to Electrical Conduit Fittings and like purposes. H. F. Joel, Sen. April 7th.
6,895. Starting Switches for Electric Motors. A. H. Curtis, A. H. Mackley & Igranic Electric Co., Ltd. May 8th.
7,080. Windings or Conductors of Electrical Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). May 11th.
7,081. Electrical Apparatus provided with Windings. British Thomson-Houston So. (General Electric Co., U.S.A.). May 11th.
8,019. Lifting Electro-magnets. Steel, Peech & Tozer, Ltd., and H. E. Bowen. May 31st.
9,101. Regulating Mechanism for Controlling the Flow of Fluids. British Thomson-Houston Co. (General Electric Co., U.S.A.). June 21st.
9,957. Preparation of Electrolytes for use in the Electrolytic Deposition of Metals. P. Marino. July 8th. (Patent of Addition not granted.)
11,262. Coating Metals. British Thomson-Houston Co. (General Electric Co. U.S.A.). August 4th.
11,515. Turbine Apparatus. Westinghouse Machine Co. August 9th. (October 17th, 1914.)
17,411. Electrical Apparatus for Heating Liquids. W. H. Smith. December 13th.